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Cover image: A specimen of *Protogrammoceras* (*Protogrammoceras*) *paltum* (Buckman) collected as float from the base of the New York Canyon type V Section by B. C. Gill in 2015. This widely distributed species ranges from the upper Pliensbachian to lower Toarcian.

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PLIENSBACHIAN–TOARCIAN (EARLY JURASSIC) AMMONOIDS FROM THE LUNING EMBAYMENT, WEST-CENTRAL NEVADA, U.S.A.

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ABSTRACT

In this study, we describe lower Pliensbachian to lower Toarcian ammonoids from 10 stratigraphic sections in the New York Canyon and Westgate areas of the Luning Embayment, Gabbs Valley, and Clan Alpine Mountain Ranges, west-central Nevada, USA. Ammonoid biostratigraphy based on 408 specimens representing 23 genera and 50 species indicates the presence of the Whiteavesi, Freboldi, Kunae, and Carlottense zones of the Pliensbachian and the Kanense Zone of the lower Toarcian. The following five new species are established (in alphabetical order): *Nodicoeloceras middlegatense* n. sp., *Nodicoeloceras nevadaense* n. sp., *Prodactylioceras westgatenses* n. sp., *Protogrammoceras* (*Matteiceras*) *tipperi* n. sp., and *Reynesocoeloceras corvalani* n. sp. A volcanic ash bed within the basal New York Canyon type V section yielded a $^{206}Pb/^{238}U$ Chemical Abrasion-Isotope Dilution-Thermal Ionization Mass Spectrometry (CA-ID-TIMS) age of 188.98 ± 0.11 Ma from the middle-upper part of the Whiteavesi Zone, which will contribute to the refinement of the early Pliensbachian timescale, an interval that is at present poorly constrained.

INTRODUCTION

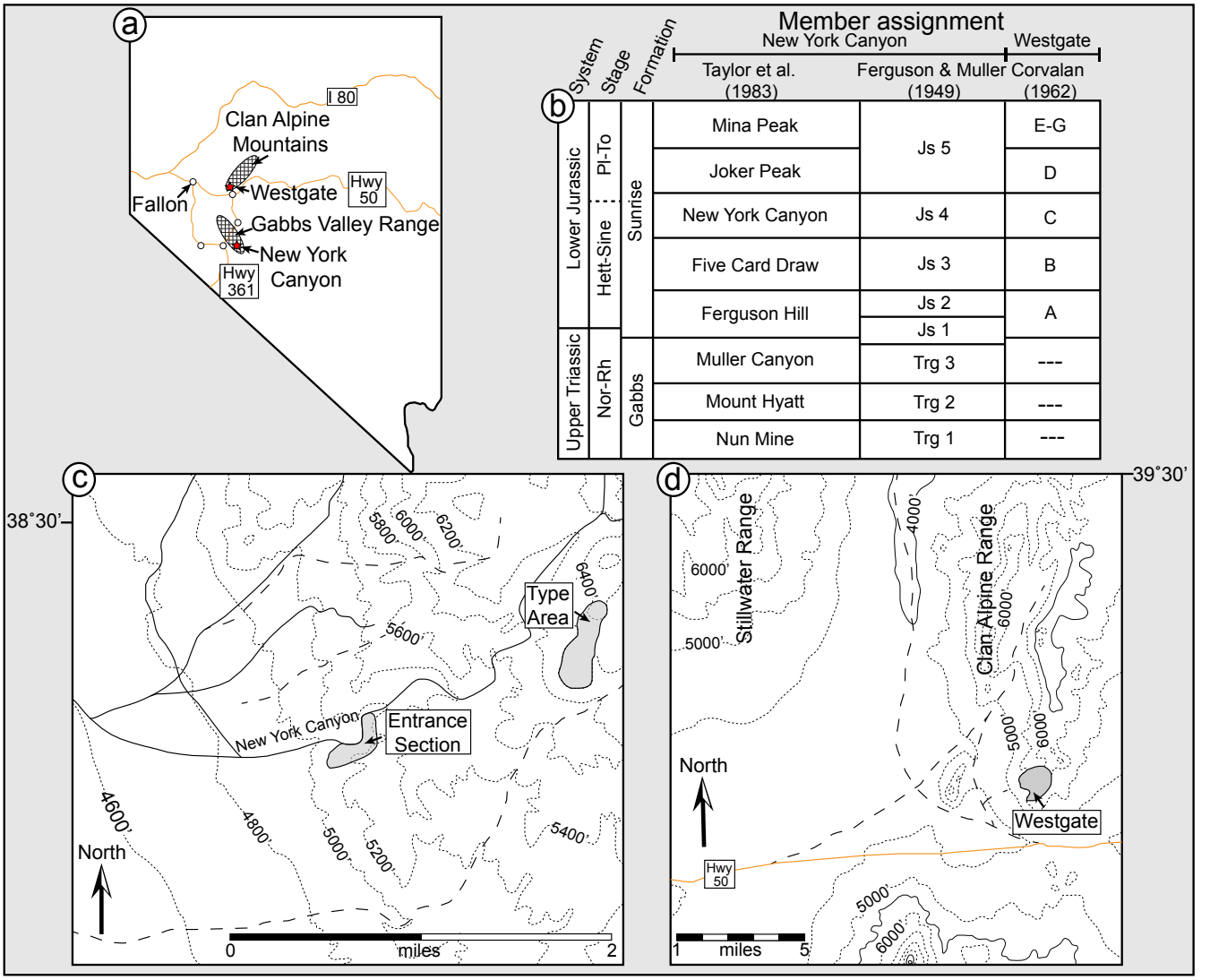
The Lower Jurassic stratigraphy of west-central Nevada has been the focus of numerous studies dating back to the early- to mid-1900s, with original research efforts aimed primarily at mapping and describing the extent of Jurassic units (Muller and Ferguson, 1936; Ferguson and Muller, 1949; Silberling, 1959; Corvalán, 1962). Later studies used plate tectonic theory and the understanding of the Cordilleran terranes (*e.g.*, Jones *et al.*, 1977; Coney *et al.*, 1980) to decipher the lithotectonic assemblages, depositional environments, and biostratigraphy of the region (Stanley 1971; Stanley *et al.*, 1971; Speed, 1979; Smith, 1981; Taylor *et al.*, 1983; Oldow, 1984; and others). Despite these studies, however, there is no detailed temporal framework for the Pliensbachian and Toarcian stratigraphy of west-central Nevada. This is essential in order to: 1) correlate local lithostratigraphy through new taxonomic and biochronologic information over this time interval; 2) further document and improve the standard North American ammonoid zone scheme for parts of the Pliensbachian (Smith *et al.*, 1988) and Toarcian (Jakobs *et al.*, 1994); 3) provide new information relevant to low-latitude ammonoid paleobiogeography on the relatively stable craton margin (*e.g.*, Smith and Tipper, 1986; Smith, 2006); and 4) support subsequent studies aimed at understanding long-term biogeochemical and sedimentological changes that may be related to the causes and dynamics of the protracted Pliensbachian–Toarcian mass extinctions (*e.g.*, Pálfy and Smith, 2000; Caruthers *et al.*, 2013 and references therein).

Here we assess ammonoid taxonomy and biochronology of the Pliensbachian–Toarcian transition in the Luning Embayment of west-central Nevada, USA. Ammonites were collected and described from 10 stratigraphic sections representing two areas within the embayment, namely at New York Canyon in the Gabbs Valley Range, and at Westgate in the Clan Alpine Mountain Range (Text-fig. 1A). In total, seven sections were measured in the New York Canyon area and three in Westgate (Text-figs. 1C, 1D; 2). The Westgate Ridge Section is a compilation of data presented by Corvalán (1962) and Smith (1981), with new information collected by the current study. Data for the New York Canyon type V Section are also compiled from Smith (1981) and the current study. Data presented for all remaining stratigraphic sections described herein are new. Although certain Pliensbachian ammonite species have been previously identified from the Luning Embayment and used to help establish the current Pliensbachian zone scheme of western North America, as described by Smith *et al.* (1988), a full account of the Pliensbachian–Toarcian transition and the taxonomic diversity within this embayment has not been presented previously.

Geological setting

The Luning Embayment is a Mesozoic cratonal, carbonate-rich sequence deposited on crystalline basement in west-central Nevada during the Triassic–Jurassic (Ferguson and Muller, 1949). The embayment is considered a component of the Walker Lake Terrane, and was accreted to the craton prior to the Jurassic (Silberling, 1959; Oldow, 1978; 1984; Taylor and Smith, 1992). The Lower Jurassic Sunrise Formation is a eustatically controlled, shallow- to deeper-water marine sequence that sits conformably above limestones of the Upper Triassic Gabbs Formation (Taylor *et al.*, 1983). The Sunrise Formation has been subdivided into five conformable members which, stratigraphically from the base, include the Ferguson Hill, Five Card Draw, New York Canyon, Joker Peak, and Mina Peak members (Text-fig. 1B; Taylor *et al.*, 1983).

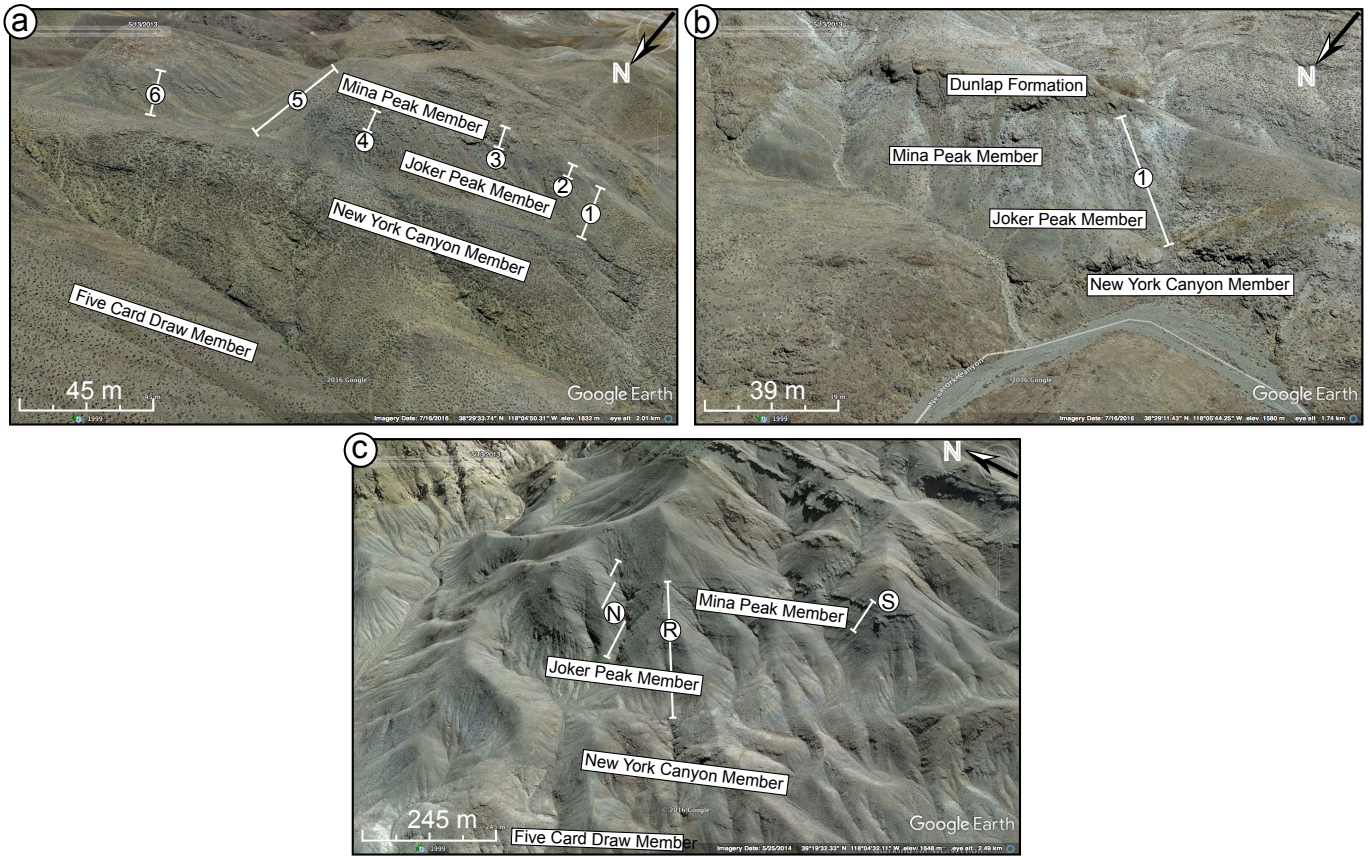
At the base of the Sunrise Formation, the Ferguson Hill Member consists of 55 m of carbonaceous siltstone and limestone that are of Hettangian to early Sinemurian age (Text-fig. 1B; Taylor *et al.*, 1983; Guex, 1995; Taylor, 1998; Ritterbush *et al.* 2016). It is overlain by the 100 m thick transgressive series of fine-grained, dark gray to black carbonaceous mudstone and siltstone of the Five Card Draw Member of Sinemurian age (Taylor *et al.*, 1983; 2001; Taylor, 1998; Porter *et al.*, 2014). The 120 m thick New York Canyon Member overlies this lithologically homogenous unit (Taylor *et al.*, 1983; 2001) and is a regressive, shallow-water succession that consists of moderately thick beds of bioclastic wackestone and packstone



Text-fig. 1. (a) *Map of Nevada showing the location of New York Canyon and Westgate within the Gabbs Valley and Clan Alpine Mountain Ranges, respectively.* (b) *Previous and current (Taylor et al., 1983) lithostratigraphic subdivisions for the Triassic–Lower Jurassic rocks of the Luning Embayment.* (c) *Location of the New York Canyon type area and Entrance Section in the Gabbs Valley Mountain Range.* (d) *Location of the Westgate area in the Clan Alpine Mountain Range. Hett = Hettangian; Js = Jurassic Sunrise Formation; Nor = Norian; Pl = Pliensbachian; Rh = Rhaetian; Sine = Sinemurian; To = Toarcian; Trg = Triassic Gabbs Formation.*

with minor siltstone that grades conformably upward into thick beds of bioclastic packstone that are late Sinemurian (Taylor *et al.*, 2001) to early Pliensbachian age (new data from the New York Canyon type area, presented herein). The upper bioclastic packstone beds terminate abruptly at a sharp contact with the overlying Joker Peak Member (Taylor *et al.*, 1983).

The Joker Peak Member is a 30 m thick transgressive series of gray/brown claystone with occasional thin calcareous beds that grades conformably into the 75 m thick, regressive, medium- to thick-bedded gray limestone of the Mina Peak Member (Taylor *et al.*, 1983). In both the New York Canyon and Westgate areas, the Mina Peak Member contains regular occurrences of microbialites (thrombolites and stromatolites), neomorphic chert, and calcite nodules that have replaced syndepositional gypsum nodules, which taken together suggest a shallow-water, occasionally evaporitic, depositional environment (Stanley, 1971). Further, bioclasts are exceedingly rare at New York Canyon and are quite common at Westgate, which could indicate that changes in seawater salinity were more intense in the New York Canyon area of the Luning Embayment. The Joker Peak and Mina Peak members were deposited from the early Pliensbachian (Smith *et al.*, 1988) to the early Toarcian (new data from Westgate, presented in this study).



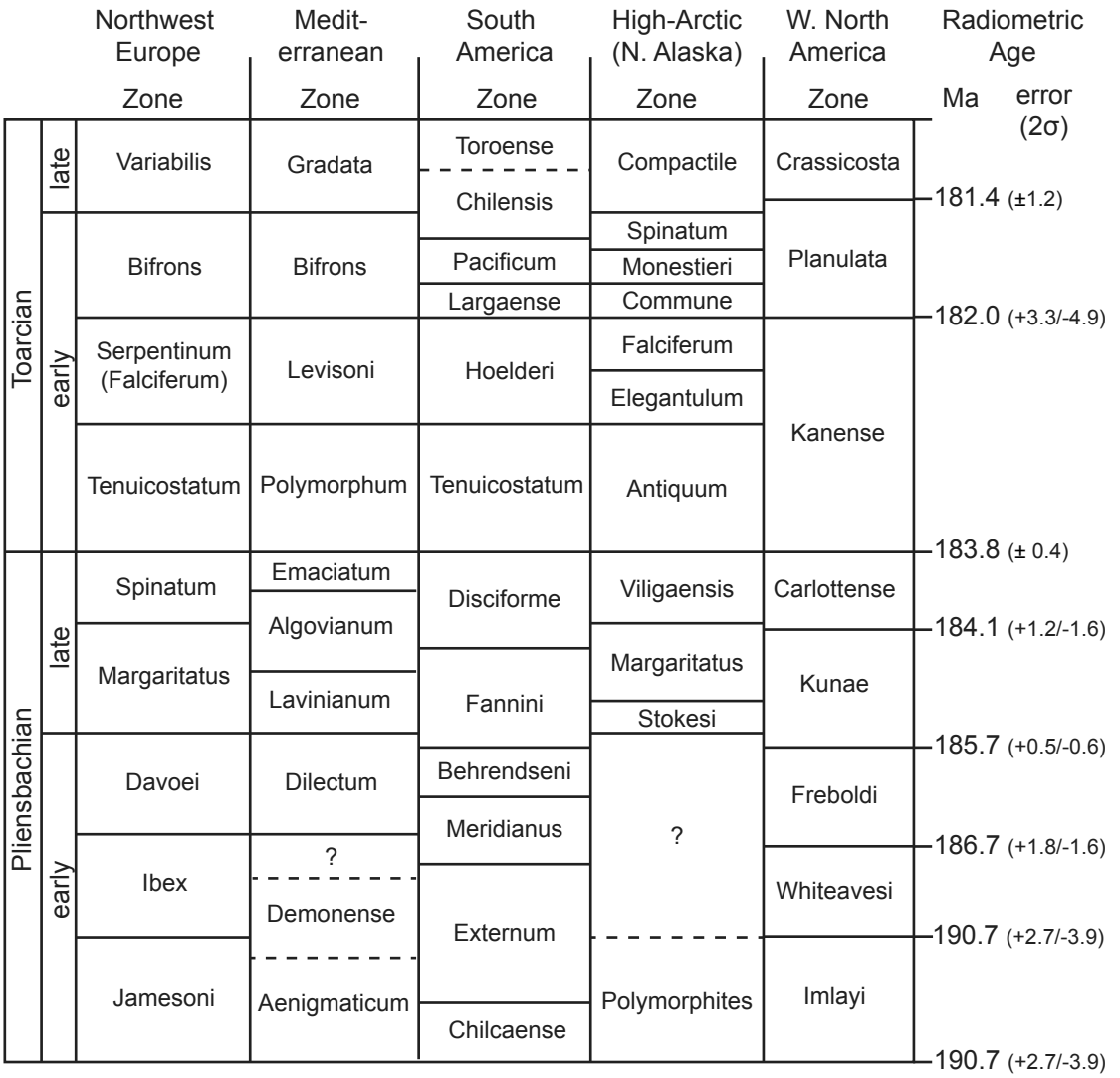
Text-fig. 2. (a) *Google Earth oblique satellite image of the New York Canyon type area showing the lithostratigraphy and locations of measured sections 1–6.* (b) *Google Earth oblique satellite image of the New York Canyon Entrance area showing lithostratigraphy and the location of the measured section.* (c) *Google Earth oblique satellite image of the Westgate District, Clan Alpine Mountains area showing the lithostratigraphy and the locations of the Westgate North (N), Ridge (R), and South (S) sections. All map data © 2016 Google.*

At Westgate, the Mina Peak Member is overlain by a ca. 130 m thick argillaceous siltstone and shale sequence (Unit G in Corvalán, 1962; Hallam, 1965; Text-fig. 1B) that contains rare occurrences of ammonites near the base (specimens described herein). This unit is not present in the New York Canyon area where the upper Mina Peak Member grades conformably into coarse sand and conglomerate of the Toarcian (?) Dunlap Formation (Taylor *et al.*, 1983; Oldow, 1984). Biostratigraphically useful fossils, however, have yet to be recovered from the Dunlap Formation and, therefore, its specific age is not conclusively known.

Pliensbachian–Middle Toarcian Timescale

Previous work has established a biochronologic and geochronologic timescale for the Pliensbachian and Toarcian of western North America that uses the chronostratigraphic concepts and zonal terminology advocated and developed by Callomon (1985) to derive a calibrated zonal scheme from fossiliferous, primarily volcaniclastic, marine sedimentary successions (Smith *et al.*, 1988; Jakobs *et al.*, 1994; Smith and Tipper, 1996; Jakobs, 1997). U–Pb and Ar–Ar dates have been obtained from zircon-bearing ash beds and lava flows interbedded in many of these sequences (Pálfy *et al.*, 1999; 2000; Gradstein *et al.*, 2012; and others). The early Pliensbachian–middle Toarcian part of this timescale, and its correlation with the ammonoid zonal schemes of NW Europe, parts of the Mediterranean, and South America are shown in Text-fig. 3. In western North America, the zones are based primarily on successions with endemic Pacific ammonoid taxa that occur in the same beds with Tethyan ammonoids. They are correlated with the Northwest European ammonoid zonal scheme mostly through co-occurring Boreal taxa which are found more commonly at high latitudes. From oldest to youngest, the North American zones referred to in our study are the Imlayi, Whiteavesi, Freboldi, Kunae, and Carlottense zones of the Pliensbachian, and the Kanense, Planulata, and Crassicosta zones of the lower and middle Toarcian (Text-fig. 3; Smith *et al.*, 1988; Jakobs *et al.*, 1994).

As it currently stands, however, radiometric ages for the lower Pliensbachian basal Imlayi, Whiteavesi, and Freboldi zone boundaries are poorly constrained and have: 1) high 2σ errors that often exceed ± 1.5 Ma; and 2) show indistinguish-



Text-fig. 3. Correlative Pliensbachian–middle Toarcian time scale for Northwest Europe and the Mediterranean (Dean et al.*, 1961; Schlatter, 1980; Braga* et al.*, 1982; Howarth, 1992; Page, 2003), South America (von Hillebrandt, 2006), High-Arctic (Zakharov* et al.*, 1997; Nikitenko* et al.*, 2008), and Western North America (Smith* et al.*, 1988; Jakobs* et al.*, 1994). Numeric ages for zone boundaries are calibrated using U–Pb and Ar–Ar age data from Pálfy* et al. *(1997; 2000), Gradstein* et al. *(2012), and astrochronological data from Ruhl* et al. *(2016). Figure adapted from compilation in Caruthers* et al. *(2013).*

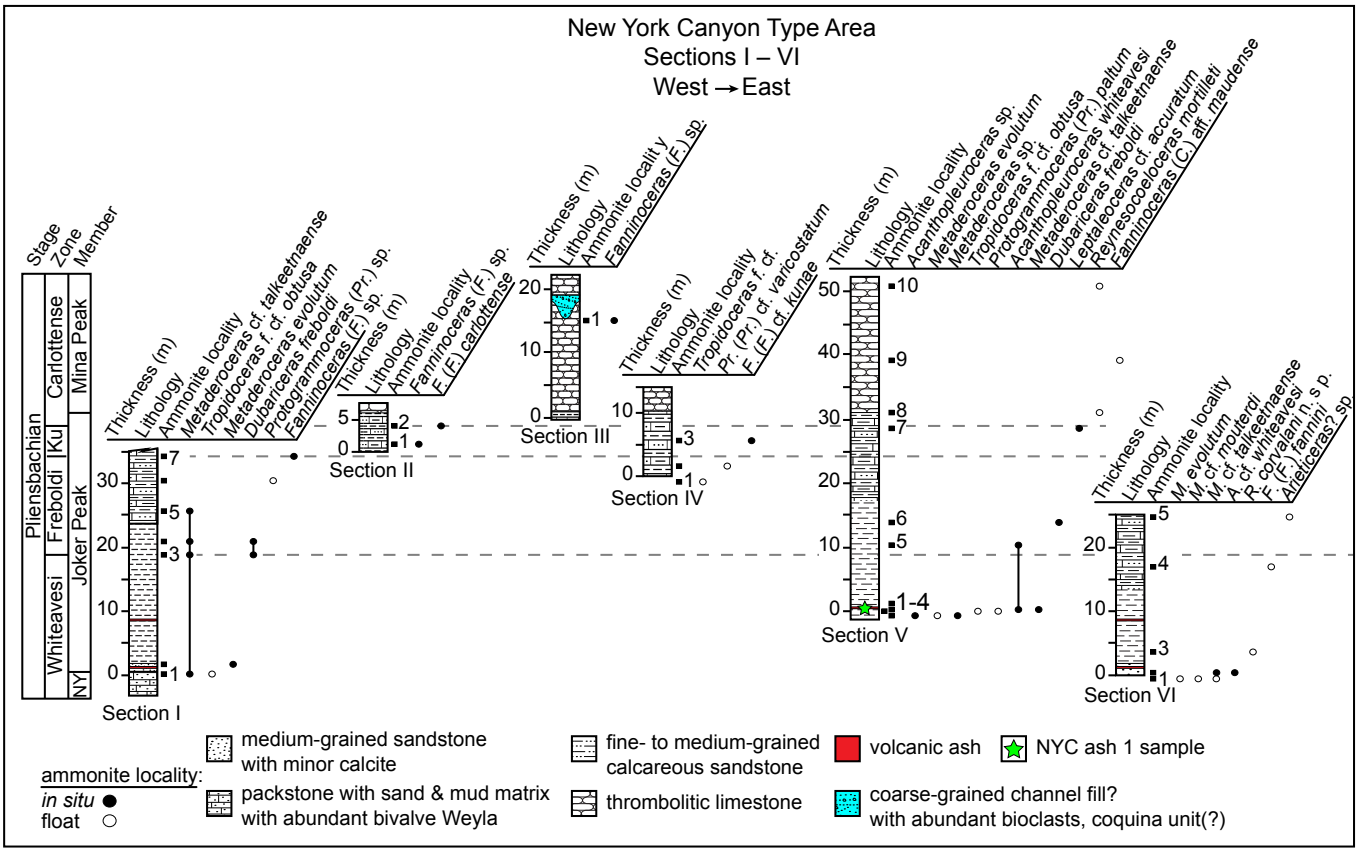
able calculated ages for consecutive zone boundaries (Text-fig. 3; table 2 in Pálfy *et al.*, 2000). The generation of radiometric dates from lower Pliensbachian units in the Luning Embayment could help refine our understanding of the duration and boundary ages of these zones.

LITHOSTRATIGRAPHIC, BIOSTRATIGRAPHIC, AND GEOCHRONOLOGIC DATA

Herein, we describe 408 ammonite specimens collected from seven sections in New York Canyon and three at Westgate (Text-fig. 2). The lithofacies suggest that deposition occurred in a shallow-water, occasionally evaporitic, nearshore marine embayment on the southwestern margin of Laurentia where fine-grained carbonates of the Joker Peak Member grade conformably upward into coarse-grained limestones of the Mina Peak Member. Collectively, ammonoid biostratigraphy from both study areas indicates the presence of the lower Pliensbachian to lower Toarcian Whiteavesi, Freboldi, Kunae, Carlottense, and Kanense Zones. We also present a new U–Pb date from the Joker Peak Member at New York Canyon that occurs in the Whiteavesi Zone and provides an age of 188.98 ± 0.11 Ma.

New York Canyon

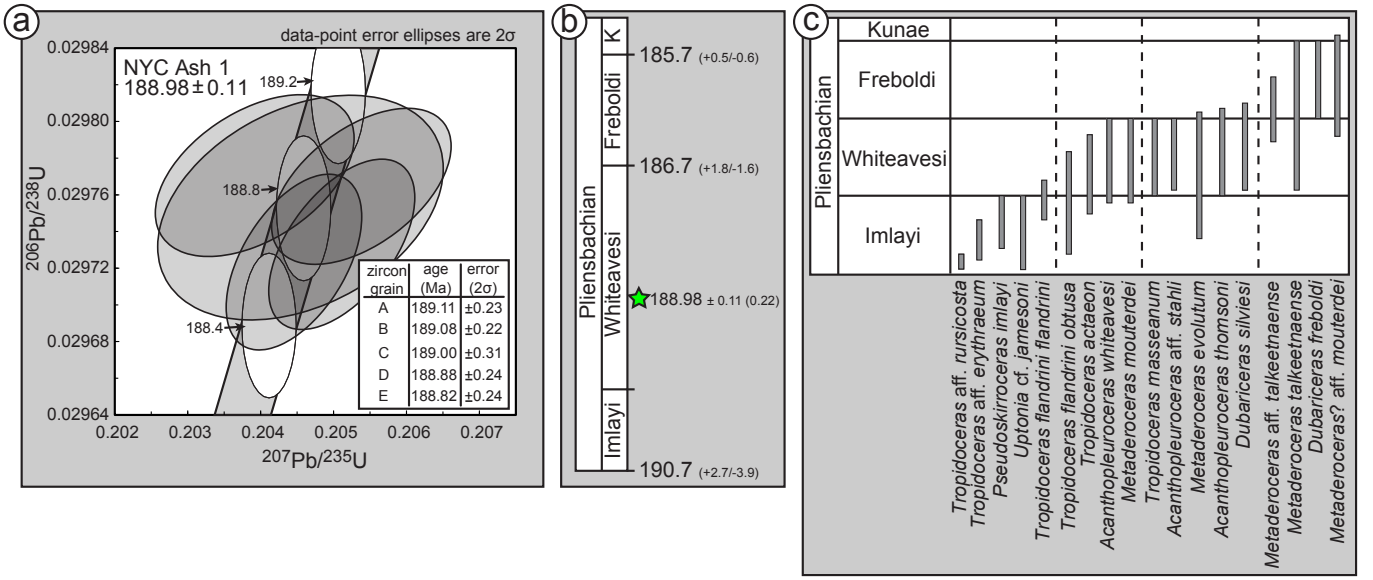
Muller and Ferguson (1936; 1939) and Ferguson and Muller



Text-fig. 4. Measured sections I–VI in the New York Canyon type area, Gabbs Valley Range west-central Nevada showing the lithostratigraphy and biostratigraphy. A. = Acanthopleuroceras; C. = Charlotticeras; F. = Fanninoceras; f. = flandrini; *Ku = Kunae;* M. = Metaderoceras; P. = Protogrammoceras; R. = Reynesocoeloceras.

(1949) designated the type section of the Lower Jurassic Sunrise Formation based on a ca. 2 km long homoclinal sequence exposed where the entrance road to New York Canyon veers northward (Text-figs. 1c, 2a). It is a ca. 65 m thick composite of six individual stratigraphic sections measured in the uppermost New York Canyon, Joker Peak, and Mina Peak members (Text-fig. 4). The basal 0.15 m consists of coarse-grained bioclastic wackestone and packstone of the New York Canyon Member (Sections I, VI). At 0.15 m there is a sharp, conformable contact with the overlying Joker Peak Member. From 0.15 to 24 m, fine-grained carbonaceous siltstone and mudstone dominate (Sections I, V, VI). This unit grades gently into a ca. 16 m thick, medium-grained sandy carbonate that occurs throughout the entire type area (Text-fig. 4) and constitutes the uppermost lithology of the Joker Peak Member. Above a sharp, conformable contact with the Mina Peak Member, the overlying ca. 25 m consists of coarse-grained, thick-bedded limestone with abundant microbialites and replaced gypsum nodules (Sections II–V). At 18 m (Section III), there is a large ca. 0.5 m thick fossiliferous packstone that is distinguished by sharp contacts and varies in thickness across the type area. This bed contains abundant shallow-water marine fossils; however, no ammonoids were recovered. At the top of the section in the New York Canyon type area, there is no evidence of an upper contact with the overlying Dunlap Formation, which suggests that the entire Mina Peak Member may not be present.

Ammonoids identified from the New York Canyon type area indicate that deposition occurred from the early to late Pliensbachian. From the base of Sections I, V, and VI to 18 m (Sections I and VI), *Metaderoceras* cf. *talkeetnaense*, *M. evolutum*, *Acanthopleuroceras whiteavesi*, *Acanthopleuroceras* sp., and *Metaderoceras* sp. were found in abundance with specimens of *Tropidoceras flandrini* cf. *obtusa* occurring as float (Text-fig. 4). This association indicates the presence of the lower Pliensbachian Whiteavesi Zone. From 18 m to 35 m, *Dubariceras freboldi* occurs in abundance together with *Acanthopleuroceras whiteavesi* (Sections I and V), suggesting a Freboldi Zone age for this interval. In the overlying ca. 5 m interval of Sections I, II, IV, and V, *Fanninoceras* (*Fanninoceras*) *kunae, Fanninoceras* (*Fanninoceras*) sp., and *Leptaleoceras* cf. *accuratum* were collected, signifying the presence of the upper Pliensbachian Kunae Zone. In western North America, the appearance of *Fanninoceras* generally marks the base of the



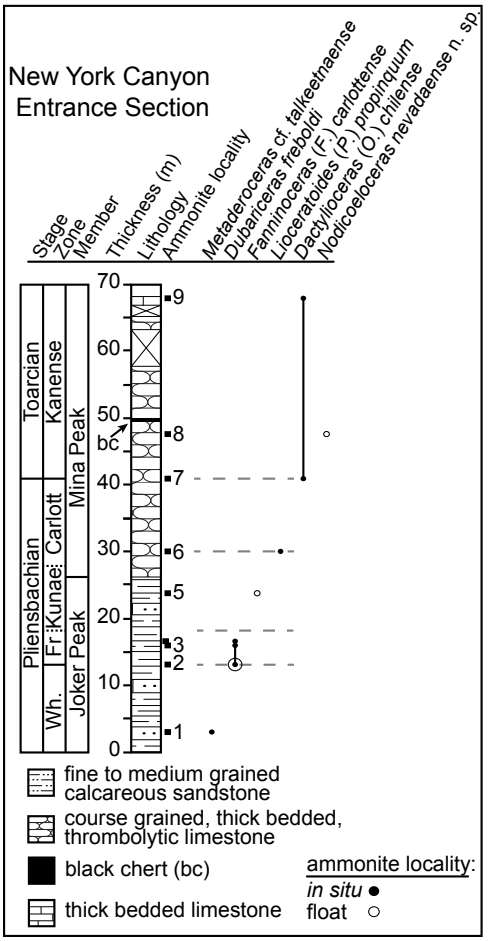
Text-fig. 5. (a) *U-Pb concordia diagram for ash sample 1, taken from Section V in the New York Canyon type area. Diagram shows* $^{206}Pb/^{238}U$ *CA-ID-TIMS ages for five zircon grains with a calculated age of crystallization to be 188.98 ± 0.11 Ma.* (b) *A comparative diagram showing the relationship of the calculated age to the calibrated geochronologic time scale within the Whiteaves Zone (Pálfy* et al.*, 1997; 2000).* (c) *Biostratigraphic range chart for the lower Pliensbachian showing selected species ranges for the Imlayi, Whiteavesi, and Freboldi zones (after Smith* et al.*, 1988; Caruthers* et al.*, 2013).*

upper Pliensbachian Kunae Zone, of which *F.* (*Fanninoceras*) *kunae* is the index species (Smith *et al.*, 1988). Just above this interval, at 4 m in Section II, *F.* (*Fanninoceras*) *carlottense* was found, which denotes the base of the uppermost Pliensbachian Carlottense Zone. In western North America, *F.* (*Fanninoceras*) *carlottense* is the index species of the Carlottense Zone and is also the stratigraphically highest ranging species of *Fanninoceras* (Smith *et al.*, 1988; Smith and Tipper, 1996). Several important float specimens were also found throughout the type area including *Protogrammoceras* (*Protogrammoceras*) cf. *varicostatum* (Section II, loc. 2), *Protogrammoceras* (*Protogrammoceras*) *paltum* (Section V, loc. 2), *Reynesocoeloceras mortilleti* (Section V, locs. 10, 8), *F.* (*Charlotticeras*) aff. *maudense* (Section V, loc. 9), *Metaderoceras* cf. *mouterdi* (Section VI, loc. 1), *Reynesocoeloceras corvalani* n. sp. (Section VI, loc. 3), *F.* (*Fanninoceras*) *fannini* (Section VI, loc. 4), and *Arieticeras*? sp. (Section VI, loc. 5).

A U–Pb Chemical Abrasion-Isotope Dilution-Thermal Ionization Mass Spectrometry (CA-ID-TIMS) age has been obtained from an ash bed occurring at 0.36 m in Section V of the New York Canyon type area (green star in Text-fig. 4). The age of this ash bed, derived from the cluster of zircon grains (A-E), is calculated to be 188.98 ± 0.11 Ma (Text-fig. 5a). The methodology and raw isotope data are presented in Appendix 1. Based on current time-scale calibrations (Pálfy *et al.*, 2000; Gradstein *et al.*, 2012), this ash bed was most likely deposited within the middle-upper part of the Whiteavesi Zone (Text-fig. 5b), in agreement with the presence of *Metaderoceras* aff. *talkeetnaense*, *Acanthopleuroceras whiteavesi*, and *M. evolutum* below this interval (Text-fig. 4; Sections I, V, VI). Although these ammonoids are generally indicative of the Whiteavesi Zone, in western North America *M.* aff. *talkeetnaense* is known to range from the middle Whiteavesi Zone to middle Freboldi Zone (Text-fig. 5c; Thomson and Smith, 1992), and therefore its presence immediately below the ash bed suggests that it is (at least) of middle Whiteavesi Zone age. This is further supported by the presence of *Dubariceras freboldi* 13 m above the ash.

A second site was studied at New York Canyon, herein denoted as the New York Canyon Entrance Section (Text-figs. 1C, 2). It is a 70 m thick succession, representing the Joker and Mina Peak members of the Sunrise Formation (Text-fig. 6). The measured section begins just above the contact with the underlying New York Canyon Member and consists of 26 m of siltstone and very fine-grained calcareous sandstone, conformably overlain by 44 m of thick-bedded limestone containing a pronounced black chert layer at 49.5 m and abundant gypsum nodules and microbialites throughout the upper part. In contrast to the New York Canyon type area, the top of the Entrance Section grades conformably into the overlying Dunlap Formation (not illustrated in Text-fig. 6), which, in comparison to the type area, suggests a potentially younger stratigraphic age for the top of the Entrance Section.

Ammonoids identified from the New York Canyon Entrance Section indicate an early Pliensbachian to early Toarcian age range. *Metaderoceras* cf. *talkeetnaense* and *Dubariceras freboldi* were recovered in abundance from 0–12 m, indicating the lower Pliensbachian Whiteavesi and



Text-fig. 6. Measured section at the entrance of New York Canyon, Gabbs Valley Range, west-central Nevada showing the lithostratigraphy and biostratigraphy. Fr = Freboldi; Carlott = Carlottense; F. = Fanninoceras*;* P. = Pacificeras*;* O. = Orthodactylites; *Wh. = Whiteavesi.*

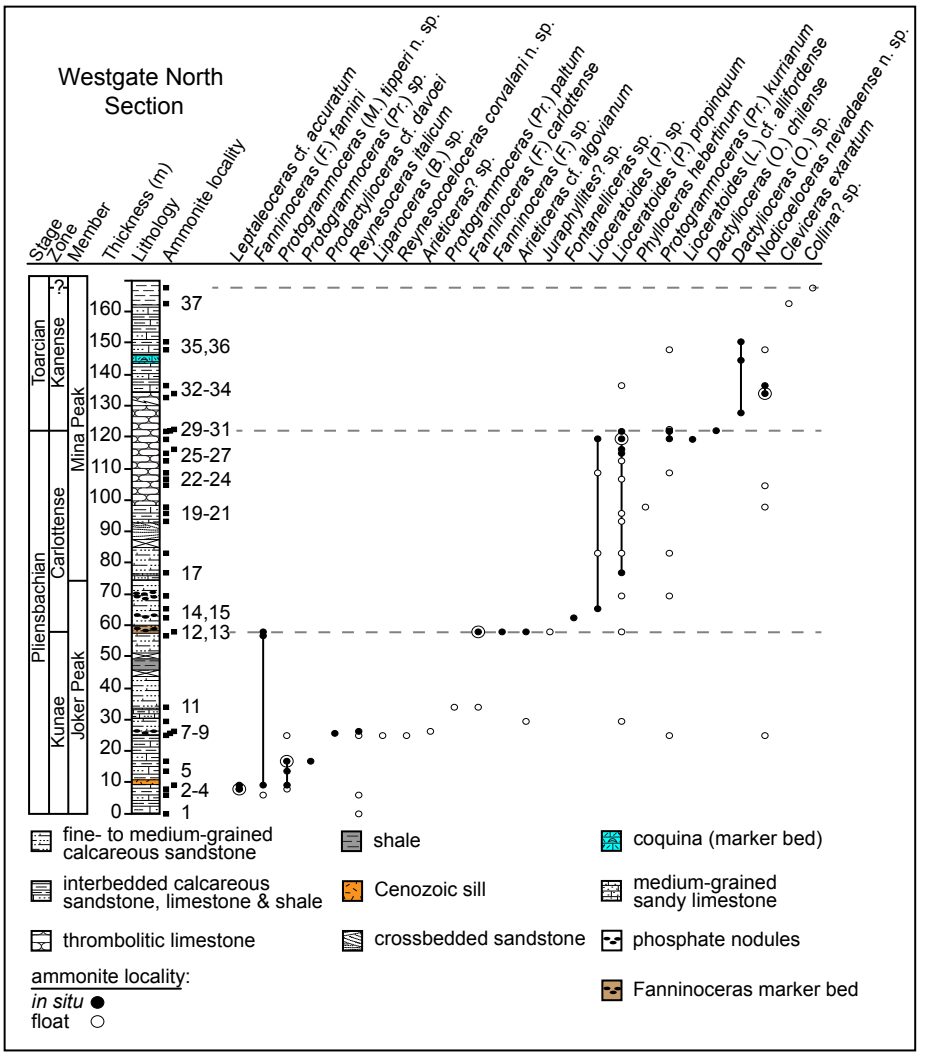
Freboldi zones (Text-fig. 6). In western North America, the base of the Freboldi Zone is drawn at the first occurrence of *D. freboldi* (Text-fig. 5c). At 30 m, *Lioceratoides* (*Pacificeras*) *propinquum* was collected, indicating the presence of the upper Pliensbachian Carlottense Zone. This is also supported by a float specimen of *Fanninoceras* (*Fanninoceras*) *carlottense* that was found at ca. 24 m. Above this interval, *Dactylioceras* (*Orthodactylites*) *chilense* was found at 41 m and 67.5 m, with a float specimen of *Nodicoeloceras nevadaense* n. sp. at ca. 47 m in the section (Text-fig. 6). In western North America, the first appearance of *Dactylioceras* above *Amaltheus* and *Fanninoceras* marks the base of the lower Toarcian Kanense Zone (Smith *et al.*, 1988; Jakobs *et al.*, 1994; Jakobs, 1997), and therefore we draw the Pliensbachian–Toarcian boundary at 41 m in the New York Canyon Entrance Section.

WESTGATE

The Lower Jurassic Sunrise Formation at Westgate crops out on the southwestern edge of the Clan Alpine Mountain Range, west-central Nevada (Text-figs. 1A,D, 2). Originally, Corvalán (1962) divided the succession into five informal members, and described mostly Pliensbachian ammonites at various localities across the mountain range. Smith (1981) and Smith *et al.* (1988) restudied the Westgate succession, which helped define the Pliensbachian ammonoid zonation scheme for western North America. Taylor *et al.* (1983) assimilated Corvalán's informal lithostratigraphy into the formal revised scheme as shown in Text-fig. 1B. In the current study, the Westgate sequence is established as a >200 m composite succession, measured in three stratigraphic sections, representing the Joker and Mina Peak members of the Sunrise Formation (Text-figs. 7–9).

The lithologic units at Westgate are broadly similar to those of New York Canyon, in that ca. 108 m of siltstone and very fine-grained calcareous sandstone of the Joker Peak Member are conformably overlain by ca. 97 m of thick-bedded, fine- to medium-grained calcareous sandstone and thrombolites of the Mina Peak Member. At Westgate, however, both members are thicker and contain more frequent shallow-water sedimentary structures, phosphate nodules, and concentrations of benthic and pelagic marine organisms. Furthermore, two marker beds are recognized within the lithostratigraphy at Westgate that can be followed laterally across the mountain (brown and blue beds in Text-figs. 7–9): 1) within the upper part of the Joker Peak Member, a thin (about 10 to 20 cm thick), more resistant, fine- to medium-grained calcareous sandstone layer with abundant phosphate nodules occurs just above concentrations of *Fanninoceras*, herein dubbed the "*Fanninoceras* marker bed"; 2) within the upper part of the Mina Peak Member, a distinct bivalve coquina (Unit F in Corvalán, 1962) crops out within the interbedded calcareous sandstone well above the thick-bedded, thrombolitic limestone interval and below the ca. 130 m thick argillite (Unit G in Corvalán, 1962; Hallam, 1965). Both marker beds are used herein to integrate the measured stratigraphic sections described at Westgate with the aggregated ammonoid localities of Corvalán (1962), Smith (1981), and this study. In the Westgate Ridge Section, the Freboldi—Kunae zone boundary is projected from the Westgate North Section based on the first occurrence of *Leptaleoceras* ca. 50 m below the *Fanninoceras* marker bed in that section (Text-fig. 7).

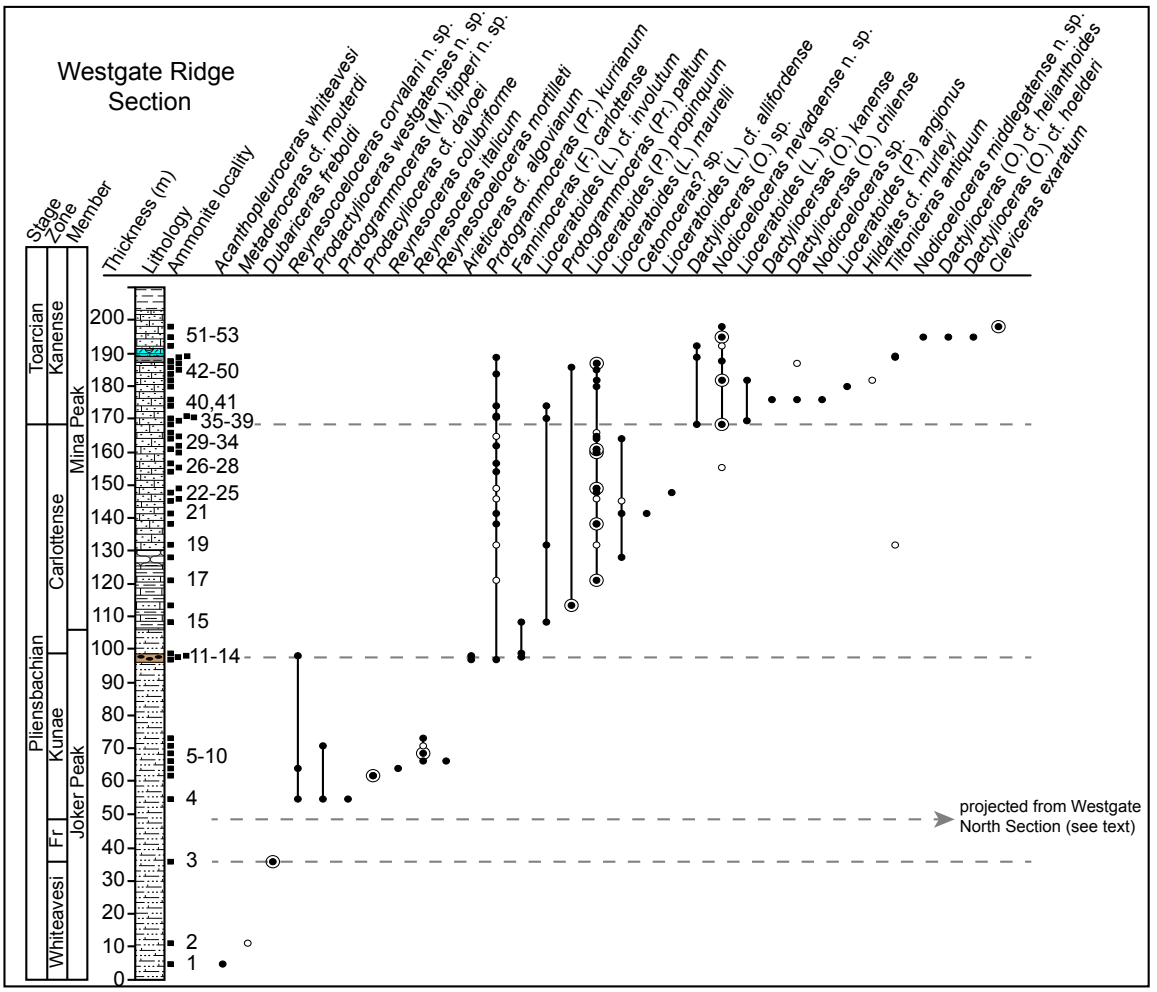
Westgate North Section.—The Westgate North Section is the northernmost measured section at Westgate, and ammonoid biostratigraphy here indicates a late Pliensbachian to early Toarcian age range. From the base to 58 m, *Leptaleoceras* cf. *accuratum, Fanninoceras* (*Fanninoceras*) *fannini*, *Protogrammoceras*



Text-fig. 7. Measured section at Westgate North, Clan Alpine Range west-central Nevada showing the lithostratigraphy and biostratigraphy. B. = Becheiceras*;* F. = Fanninoceras*;* L. = Lioceratoides*;* M. = Matteiceras*;* P. = Pacificeras*;* Pr. = Protogrammoceras*;* O. = Orthodactylites.

(*Matteiceras*) *tipperi* n. sp., *P.* (*Protogrammoceras*) sp., *Prodactylioceras* cf. *davoei*, and *Reynesoceras italicum* occur, indicating the Kunae Zone (Text-fig. 7). From 58 m to 122 m *F.* (*Fanninoceras*) *carlottense* occurs along with *F.* (*Fanninoceras*) cf. *fannini*, *F.* (*Fanninoceras*) sp., *Arieticeras* cf. *algovianum*, *Fontanelliceras* sp., *Lioceratoides* (*Pacificeras*) *propinquum, L.* (*Lioceratoides*) cf. *allifordense, Lioceratoides* (*Pacificeras*) sp., and *Protogrammoceras* (*Protogrammoceras*) *kurrianum*, indicating the Carlottense Zone. From 122 m to the top of the section, *Dactylioceras* (*Orthodactylites*) *chilense, Dactylioceras* (*Orthodactylites*) sp., and *Nodicoeloceras nevadaense* n. sp. appear in abundance, signifying the lower Toarcian Kanense Zone. *Protogrammoceras* (*Protogrammoceras*) *kurrianum* was also found *in situ* within this interval. This observation suggests that this species ranged across the Pliensbachian–Toarcian boundary at Westgate, which differs from Europe and other parts of western North America where *Protogrammoceras kurrianum* is only known from the upper Pliensbachian (Smith and Tipper, 1996).

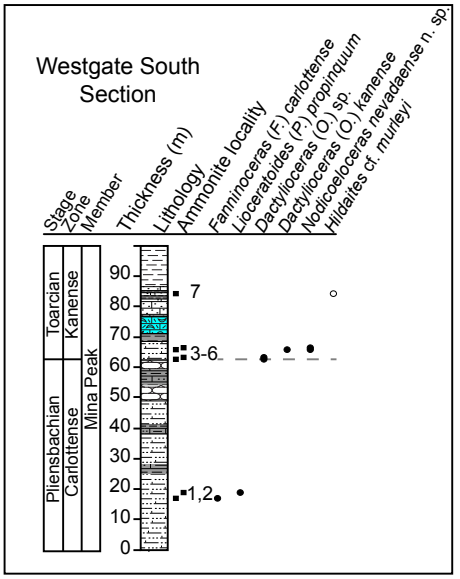
Important float specimens found throughout this section include *Liparoceras* (*Becheiceras*) sp., *Reynesocoeloceras corvalani* n. sp., *Arieticeras*? sp., *Protogrammoceras* (*Protogrammoceras*) *paltum*, *Juraphyllites*? sp., *Phylloceras hebertinum*, *Cleviceras exaratum*, and *Collina*? sp. (Text-fig. 7). Of these, *Cleviceras exaratum* and *Collina*? sp. are particularly important because these specimens: 1) were collected near the base of the ca. 130 m thick argillaceous siltstone and shale unit (Unit G in Corvalán, 1962; Hallam, 1965) of the uppermost Mina Peak Member; and 2) have stratigraphic ranges that include the middle Toarcian (see Text-fig. 3 in Jakobs, 1997). These represent the first ammonoids identified from this unit; however, at present, their exact stratigraphic position within the so-called Unit G cannot be determined.



Text-fig. 8. Measured section at Westgate Ridge, Clan Alpine Range, west-central Nevada showing the lithostratigraphy and biostratigraphy. F. = Fanninoceras*; Fr. = Freboldi;* L. = Lioceratoides*;* M. = Matteiceras*;* O. = Orthodactylites; P. = Pacificeras*;* Pr. = Protogrammoceras. *See Text-figure 7 for lithologic symbols.*

Westgate Ridge Section.—This ca. 200 m thick section is located on the ridgeline between the North and South sections (Text-fig. 2). The combined biostratigraphy of the Westgate Ridge Section is derived from this study and the previous work of Corvalán (1962) and Smith (1981). An early Pliensbachian (Whiteavesi Zone) to early Toarcian (Kanense Zone) age range is suggested for this section (Text-fig. 8). From 0 m to 35 m, *Acanthopleuroceras whiteavesi* and *Metaderoceras* cf. *mouterdi* (float) indicate the Whiteavesi Zone. *Dubariceras freboldi* was found *in situ* and as float at 35 m, suggesting the Freboldi Zone at this level. As mentioned previously, the Freboldi—Kunae zone boundary is projected at 48 m in the section based on the first occurrence of *Leptaleoceras* below the *Fanninoceras* marker bed in the Westgate North Section (Text-fig. 7).

From 48 m to 98 m, *Reynesocoeloceras corvalani* n. sp., *Prodactylioceras westgatenses* n. sp., *Protogrammoceras* (*Matteiceras*) *tipperi* n. sp., *Prodactylioceras* cf. *davoei*, *Reynesoceras colubriforme* (float), *Reynesoceras italicum*, *Reynesocoeloceras mortilleti*, *Arieticeras* cf. *algovianum*, and *Protogrammoceras* (*Protogrammoceras*) *kurrianum* indicate the Kunae Zone. From 98 m to 169 m, *Fanninoceras* (*Fanninoceras*) *carlottense* occurs together with *Arieticeras* cf. *algovianum*, *Lioceratoides* (*Lioceratoides*) cf. *involutum*, *Protogrammoceras* (*Protogrammoceras*) *paltum*, *L.* (*Pacificeras*) *propinquum*, *Protogrammoceras* (*Protogrammoceras*) *kurrianum*, *L.* (*Lioceratoides*) *maurelli*, *Cetonoceras*? sp., and *L.* (*Lioceratoides*) cf. *allifordense*, indicating the Carlottense Zone. At 169 m, the first occurrence of *Dactylioceras* marks the base of the Toarcian. From 169 m to ca. 200 m in the section, *Dactylioceras* (*Orthodactylites*) sp. and *Nodicoeloceras nevadaense* n. sp. occur together with *L.* (*Lioceratoides*) cf. *involutum*, *L.* (*Pacificeras*) *propinquum, Lioceratoides* (*Lioceratoides*) sp., *Protogrammoceras* (*Protogrammoceras*) *kurrianum, Protogrammoceras* (*Protogrammoceras*) *paltum, D.* (*Orthodactylites*) *kanense, D.* (*Orthodactylites*) *chilense,*



Text-fig. 9. Measured section at Westgate South, Clan Alpine Range, west-central Nevada showing the lithostratigraphy and biostratigraphy. F. = Fanninoceras*;* O. = Orthodactylites; P. = Pacificeras*. See Text-fig. 7 for lithologic symbols.*

Nodicoeloceras sp., *L.* (*Pacificeras*) *angionus*, *Hildaites* cf. *murleyi* (float), *Tiltoniceras antiquum*, *N. middlegatense* n. sp., *D.* (*Orthodactylites*) cf. *helianthoides*, *D.* (*Orthodactylites*) cf. *hoelderi*, and *Cleviceras exaratum,* indicating the lower Toarcian Kanense Zone.

Westgate South Section.—The Westgate South Section is the southernmost section measured at Westgate (Text-fig. 2). It is a ca. 90 m thick succession of the Mina Peak Member of the Sunrise Formation that spans the upper Pliensbachian Carlottense Zone to the lower Toarcian Kanense Zone. From the base to 61 m, *Fanninoceras* (*Fanninoceras*) *carlottense* and *Lioceratoides* (*Pacificeras*) *propinquum* occur, indicating the Carlottense Zone (Text-fig. 9). At 61 m, *Dactylioceras* (*Orthodactylites*) sp., *Dactylioceras* (*Orthodactylites*) *kanense*, *Nodicoeloceras nevadaense* n. sp., and *Hildaites* cf. *murleyi* (as float) were recovered, indicating the lower Toarcian Kanense Zone.

As within the Westgate Ridge Section, the bivalve coquina marker bed at Westgate South occurs well above *Dactylioceras* (*Orthodactylites*) *kanense* and below the first occurrence of *Cleviceras exaratum* (Text-figs. 8, 9), suggesting that this unit is temporally constrained to the middle part of the Kanense Zone (compare stratigraphic ranges in Jakobs, 1997, fig. 3).

SYSTEMATIC PALEONTOLOGY

Ammonoid taxa are described following the recommendations for open nomenclature of Bengtson (1988). Specimens examined are curated at the University of Montana Paleontology Center (UMPC) in Missoula, Montana and are listed in Appendix 2. Shell dimensions and other measurements discussed herein are presented in Table 1. The following abbreviations used for measurements are after Smith (1986) and Liang and Smith (1997):

D = shell diameter
UD = umbilical diameter at diameter D
U = (UD/D) × 100
WH = whorl height at diameter D
WHD = (WH/D) × 100
WW = whorl width at diameter D
WWD = (WW/D) × 100
WWWH = (WW/WH) × 100
PRHW = primary ribs per half whorl, counted on the half whorl terminating at the shell diameter.

Class **CEPHALOPODA** Cuvier, 1797
Order **AMMONOIDEA** Zittel, 1884
Suborder **PHYLLOCERATINA** Arkell, 1950
Family **PHYLLOCERATIDAE** Zittel, 1884
Genus ***PHYLLOCERAS*** Suess, 1865

Type species.—Ammonites heterophyllus Sowerby, 1820, pl. 226.

Phylloceras hebertinum (Reynès, 1868)
Plate 1, figure 1

Ammonites hebertinus Reynès, 1868: 94, pl. 2, fig. 3.
Phylloceras hebertinum. Hillebrandt, 2006: 35, pl. 1, figs. 1–3 (and synonymy therein).

Material examined.—One moderately well-preserved specimen from locality 21, Westgate North Section; see Appendix 2.

Occurrence and age.—Phylloceras hebertinum ranges from the Sinemurian to Pliensbachian of Europe and South America (Hillebrandt, 2002; 2006). Our float specimen from Nevada is most likely late Pliensbachian (Carlottense Zone) based on the occurrence of *Fanninoceras* (*Fanninoceras*) *carlottense* below.

Description—An involute, rapidly expanding form ~11 cm in diameter (D) with compressed ellipsoidal whorls (UMPC 15041; Table 1), a smooth, rounded venter bearing no keel, and a rounded umbilical shoulder. Ribs are faint or absent along the flank.

Remarks.—We place our specimen in *P. hebertinum* based on

Table 1. Measurements of selected taxa from all measured sections in this study. See text for abbreviated subgeneric and subspecies names. All measurements are in centimeters (cm); ***bold*** *text denotes inner whorl dimensions.*

Taxonomic identification, curation number	D	UD	U	WH	WHD	WW	WWD	WWWH	PRHW
Phylloceras hebertinum, UMPC 15041	11.10	1.20	10.81	6.20	55.86	5.30	85.48	85.48	---
Fanninoceras (*F.*) *carlottense,* UMPC 15043	7.00	0.40	5.71	3.80	54.29	1.50	39.47	39.47	---
Fanninoceras (*F.*) *fannini,* UMPC 15058	3.00	0.50	16.67	1.79	59.67	0.64	35.75	35.75	15
Fanninoceras (*F.*) *fannini,* UMPC 15057	2.79	0.50	17.95	1.45	52.06	0.63	43.45	43.45	---
Fanninoceras (*C.*) *maudense,* UMPC 15063	2.59	0.47	18.15	1.31	50.58	---	---	---	17
Acanthopleuroceras whiteavesi, UMPC 15066	---	---	---	1.15	---	0.81	70.43	70.43	---
Acanthopleuroceras whiteavesi, UMPC 15311	2.27	1.28	56.39	0.80	35.24	---	---	---	18
Acanthopleuroceras sp., UMPC 15068	---	7.75	---	2.13	---	---	---	---	19
Tropidoceras flandrini cf. *obtusa,* UMPC 15071	---	---	---	9.88	---	8.61	87.15	87.15	---
Tropidoceras flandrini cf. *obtusa,* UMPC 15069	---	---	---	5.63	---	5.28	93.78	93.78	---
Tropidoceras flandrini cf. *obtusa,* UMPC 15072	---	---	---	6.59	---	6.38	96.81	96.81	---
***Dubariceras freboldi,* UMPC 15073**	**---**	**2.31**	**---**	**3.09**	**---**	**---**	**---**	**---**	---
***Dubariceras freboldi,* UMPC 15074**	**---**	**3.30**	**---**	**1.59**	**---**	**---**	**---**	**---**	28
Metaderoceras evolutum, UMPC 15089	5.27	2.64	50.09	1.62	30.74	1.10	67.90	67.90	---
***Metaderoceras evolutum,* UMPC 15090**	**---**	**2.78**	**---**	**1.30**	**---**	**1.13**	**86.92**	**86.92**	---
Metaderoceras cf. *mouterdi,* UMPC 15094	---	---	---	1.30	---	1.64	126.15	126.15	---
Metaderoceras cf. *talkeetnaense,* UMPC 15099	---	---	---	5.55	---	---	---	---	---
Metaderoceras cf. *talkeetnaense,* UMPC 15105	---	---	---	1.78	---	---	---	---	---
Reynesocoeloceras mortilleti, UMPC 15108	---	---	---	3.26	---	---	---	---	---
***Reynesocoeloceras corvalani* n. sp., UMPC 15110**	**---**	**2.47**	**---**	**0.78**	---	**1.30**	---	---	---
Reynesocoeloceras corvalani n. sp., UMPC 15112	7.10	4.03	56.76	1.58	22.25	2.83	179.11	179.11	---
***Prodactylioceras* cf. *davoei,* UMPC 15115**	**5.08**	**2.80**	**55.12**	**2.59**	**50.98**	**3.09**	**119.31**	**119.31**	47
***Prodactylioceras westgatenses* n. sp., UMPC 15117**	**8.22**	**8.22**	**100.00**	**3.40**	**41.36**	**4.28**	**125.88**	**125.88**	---
Cetonoceras?, UMPC 15119	4.92	3.05	61.99	1.62	32.93	---	---	---	28
Reynesoceras colubriforme, UMPC 15120	---	3.27	---	1.31	---	1.78	135.88	135.88	---
Reynesoceras italicum, UMPC 15121	---	6.02	---	1.62	---	---	---	---	47
***Reynesoceras italicum,* UMPC 15122**	**---**	**6.42**	**---**	**3.15**	**---**	**---**	**---**	**---**	---
Dactylioceras chilense, UMPC 15136	---	---	---	3.10	---	2.31	74.52	74.52	---
Dactylioceras chilense, UMPC 15135	8.25	4.10	49.70	2.44	29.58	1.79	73.36	73.36	---
Dactylioceras cf. *helianthoides,* UMPC 15141	2.44	1.30	53.28	0.78	31.97	1.05	134.62	134.62	---
Dactylioceras cf. *hoelderi,* UMPC 15142	4.12	---	---	1.78	43.20	1.32*	---	---	---
Dactylioceras kanense, UMPC 15144	---	---	---	---	---	0.63	---	---	---
Dactylioceras kanense, UMPC 15143	1.15	0.46	40.00	0.47	40.87	---	---	---	---
Nodicoeloceras nevadaense n. sp., UMPC 15171	6.76	3.09	45.71	2.26	33.43	3.58	158.41	158.41	---
Nodicoeloceras nevadaense n. sp., UMPC 15168	---	---	---	1.63	---	4.80	294.48	294.48	---
Nodicoeloceras nevadaense n. sp., UMPC 15146	---	---	---	2.14	---	4.43	207.01	207.01	---
***Nodicoeloceras middlegatense* n. sp., UMPC 15175**	**7.37**	**3.63**	**49.25**	**2.39**	**32.43**	**---**	**---**	**---**	25
Liparoceras (*B.*) sp., UMPC 15177	---	---	---	---	---	10.53	---	---	---
Arieticeras cf. *algovianum,* UMPC 15180	---	---	---	10.30	---	---	---	---	---
Arieticeras cf. *algovianum,* UMPC 15179	2.12	1.45	68.40	0.65	30.66	0.65	100.00	100.00	17
Leptaleoceras cf. *accuratum,* UMPC 15184	2.46	0.81	32.93	0.84	34.15	---	---	---	---
Protogrammoceras kurrianum, UMPC 15190	4.77	1.27	26.62	2.01	42.14	1.27	63.18	63.18	---
Protogrammoceras kurrianum, UMPC 15190	7.39	2.13	28.82	3.13	42.35	2.58	82.43	82.43	---
Protogrammoceras kurrianum, UMPC 15208	---	---	---	5.74	---	3.75	65.33	65.33	---
Protogrammoceras paltum, UMPC 15215	7.06	3.60	50.99	2.65	37.54	1.64	61.89	61.89	22
Protogrammoceras cf. *varicostatum,* UMPC 15220	---	---	---	2.08	---	1.29	62.02	62.02	---
Protogrammoceras tipperi n. sp., UMPC 15223	15.50	5.25	33.87	6.06	39.10	---	---	---	---
Protogrammoceras tipperi n. sp., UMPC 15224	---	---	---	1.62	---	---	---	---	---
	---	---	---	3.15	---	---	---	---	---
	---	---	---	5.75	---	---	---	---	---
Lioceratoides maurelli, UMPC 15236	7.80	1.83	23.46	3.60	46.15	---	---	---	---
Lioceratoides angionus, UMPC 15241	6.10	1.79	29.34	2.60	42.62	2.30	88.46	88.46	---
Lioceratoides propinquum, UMPC 15252	5.54	2.01	36.28	2.22	40.07	---	---	---	---
Lioceratoides propinquum, UMPC 15258	3.38	1.03	30.47	1.50	44.38	0.61	40.67	40.67	---
Lioceratoides propinquum, UMPC 15247	4.28	1.30	30.37	1.83	42.76	---	---	---	---
Lioceratoides propinquum, UMPC15273	3.80	1.03	27.11	1.71	45.00	1.03	60.23	60.23	---
Cleviceras exaratum, UMPC 15293	10.37	2.60	25.07	4.80	46.29	3.00	62.50	62.50	---

the high degree of shell involution, the ellipsoidal whorl section with a rounded umbilical shoulder, and rounded venter. Specimens assigned to *P.* gr. *frondosum hebertinum* in Meister *et al.* (2011), Blau and Meister (2011), and Meister and Blau (2014) are much smaller than our specimen from Nevada, which makes comparison difficult. In comparison with *P. meneghinii* in Venturi *et al.* (2005), however, the whorl of *P. hebertinum* is more ellipsoidal with a steeper umbilical wall.

Family **JURAPHYLLITIDAE** Arkell, 1950
Genus ***JURAPHYLLITES*** Muller, 1939

Type species.—*Phylloceras diopsis* Gemmellaro, 1884.

Juraphyllites? sp.
Plate 1, figures 2–4

Material examined.—One fragment from locality 13, Westgate North Section; see Appendix 2.

Occurrence and age.—*Juraphyllites* is a geographically widespread, characteristically Tethyan genus that ranges throughout the Early Jurassic (Taylor *et al.*, 2001; Rakus and Guex, 2002; Meister *et al.*, 2011). Our float specimen from Nevada is most likely late Pliensbachian (Carlottense Zone) based on the presence of *Fanninoceras* (*Fanninoceras*) *carlottense* from this horizon.

Description.—Small, compressed, ellipsoidal whorl fragment with strong, simple, flexuous, or slightly sinuous primary ribs projecting across the flank and venter. No keel is present.

Remarks.—The oval whorl, lack of keel, and coarse sinuous ribs that project across the venter characterize the genus. In comparison, the ribs along the inner whorls of *J. planispira* (Reynès) of Rakus and Guex (2002), *J. libertus* (Müller) of Meister (1986), and *J. libertus australis* of Hillebrandt (2006) are absent or fine, which is different from whorls of comparable dimensions in our Nevada specimen which has ribs that are coarse and extend across the flank and venter. Our specimen is a fragment, however, so it cannot be identified with confidence.

Suborder **AMMONITINA** Hyatt, 1889
Family **POLYMORPHITIDAE** Haug, 1887
Subfamily **ACANTHOPLEUROCERATINAE** Arkell, 1950
Genus ***ACANTHOPLEUROCERAS*** Hyatt, 1900

Type species.—*Ammonites valdani* d'Orbigny, 1844.

Acanthopleuroceras whiteavesi Smith and Tipper, 1988
Plate 2, figures 9–11

cf. *Tropidoceras actaeon* (*d'Orbigny,* 1844). Frebold, 1970: p. 440, pl. 2, figs. 13–15.
cf. *Acanthopleuroceras whiteavesi* Smith and Tipper, 1988: p. 1519, pl. 2, figs. 1–4; Smith and Tipper, 1996: p. 36, pl. 7, figs. 6–10; text-figs. 26c, 32g–h (and synonymy therein).

Material examined.—Seven fragmentary specimens in total: five from localities 3 and 5, New York Canyon type V Section; one from locality 2, New York Canyon type VI Section; and one from locality 1, Westgate Ridge Section; see Appendix 2.

Occurrence and age.—This species is restricted to the lower Pliensbachian Whiteavesi Zone of western North America, and is reported from Oregon (Smith *et al.*, 1988; Smith and Tipper, 1996) and British Columbia (Haida Gwaii).

Description.—Evolute with a sub-circular whorl, rounded flanks, a wide umbilicus, and incipient keel (UMPC 15311; WH = 0.8 cm, UD = 1.3 cm). Strong, regularly spaced, flexuous ribs occur along the flank and project gently onto the venter.

Remarks.—In comparison to *Acanthopleuroceras thomsoni, A. whiteavesi* lacks densely spaced rursiradiate ribs and tubercles on the ventrolateral area.

Acanthopleuroceras sp.
Plate 2, figure 12

Material examined.—One specimen—an external mold—from locality 1, New York Canyon type V Section; see Appendix 2.

Occurrence and age.—*Acanthopleuroceras* is a cosmopolitan genus that is restricted to the lower part of the Pliensbachian. Our specimen from the New York Canyon type V Section (Nevada) occurs together with *Metaderoceras evolutum*, just below the first occurrence of *A. whiteavesi*, and is therefore probably Whiteavesi Zone in age.

Description.—Evolute with a quadrate whorl section, flat flanks, and a sharp umbilical wall. Straight ribs project rursiradiately across the flank between two sets of tubercles, one row at the umbilical shoulder and another along the ventrolateral edge.

Remarks.—This species of *Acanthopleuroceras* is distinguished by the strong bituberculate simple ribs that trend rursiradiately across the flank. Our specimen resembles *A. valdani* in

Schlatter (1977, Pl. 4, fig. 1) and Howarth (2013, fig. 38–1a, b) in terms of the strong, coarse, bituberculate primary ribs. It differs, however, by its rursiradiate ribs. *Acanthopleuroceras* sp. differs from *A. thomsoni* and *A. whiteavesi* by its coarse bituberculate ribs and, in the case of *A. whiteavesi*, a rounder umbilical wall.

Genus ***TROPIDOCERAS*** Hyatt, 1867

Type species.—*Ammonites masseanum* d'Orbigny, 1848.

Tropidoceras flandrini cf. ***obtusa*** (Futterer, 1893)
Plate 2, figures 13, 14; Plate 3, figures 1–3

cf. *Cycloceras flandrini* var. *obtusa* Futterer, 1893: 334, pl. 13, fig. 1.
cf. *Tropidoceras flandrini obtusa.* Smith and Tipper, 1996: 38, pl. 8, fig. 5; pl. 9, figs. 3, 5 (and synonymy therein).
cf. *Tropidoceras flandrini* cf. *obtusa.* Hillebrandt, 2006: 98, pl. 21, fig. 4, 5; pl. 22, figs. 1–5; pl. 23, figs. 1–6; pl. 24, figs. 2–6; text-fig. 18c–p. (and synonymy therein).

Material examined.—Four fragmentary specimens in total: two from locality 1, New York Canyon type I Section; one from locality 1, New York Canyon type IV Section; and one from locality 2, New York Canyon type V Section; see Appendix 2.

Occurrence and age.—*Tropidoceras flandrini obtusa* is known from the lower Pliensbachian (Jamesoni and Ibex zones) of Germany (Schlatter, 1980), Turkey (Alkaya and Meister, 1995), Chile and Argentina (Hillebrandt, 2006), and parts of British Columbia (Haida Gwaii and Spatsizi area; Thomson and Smith, 1992; Smith and Tipper, 1996). In the New York Canyon type area, this species occurs along with *Metaderoceras talkeetnaense* and is most likely Whiteavesi Zone in age.

Description.—Highly evolute with a sub-quadrate section, flat flanks, and a rounded umbilical wall. Venter bears a subdued keel. Coarse, simple, primary ribs project from the umbilical wall and become more pronounced on the upper flank where they project onto the venter from distinct ventrolateral tubercles. Weaker secondary ribs project from the upper flank onto the venter, terminating at the keel.

Remarks.—Our specimens are difficult to place taxonomically because they have some features typical of *Acanthopleuroceras* (rectangular whorl section, low blunt keel) and some typical of *Tropidoceras* (well developed secondary ribbing). The closest similarity seems to be with the variant *T. f. obtusa,* which differs from *T. f. flandrini* by having coarser, less densely spaced ribbing (Smith and Tipper, 1996). The fragmentary nature of recovered specimens at New York Canyon precludes positive identification.

Family EODEROCERATIDAE Spath, 1929
Genus ***FANNINOCERAS*** McLearn, 1930

Type species.—*Fanninoceras fannini* McLearn, 1930.

Remarks.—We follow Howarth (2013) by placing the genus *Fanninoceras* into the family Eoderoceratidae, rather than Dubariceratidae (*e.g.* Hillebrandt, 2006) or Oxynoticeratidae (*e.g.* Smith and Tipper, 1996) because: 1) Dubariceratidae (in Dommergues and Meister, 1999, p. 282) is no longer considered a valid designation (Howarth, 2013, p. 38); and 2) the demonstration of an evolutionary series that connects *Eoamaltheus* with *Andidiscus* and *Fanninoceras* in South America precludes its inclusion in Oxynoticeratidae (Howarth, 2013, p. 42 and references therein).

Subgenus ***FANNINOCERAS*** McLearn, 1930

Type species.—*Fanninoceras fannini* McLearn, 1930.

Fanninoceras* (*Fanninoceras*) *carlottense McLearn, 1930
Plate 1, figures 5–11

Fanninoceras (*Fanninoceras*) *carlottense*. Smith and Tipper, 1986: 401, fig. 2.7 (this specimen is refigured herein, Pl. 1, Figs. 5–7); Smith *et al.*, 1988: 1516, pl. 5, figs. 9–11; Smith and Tipper, 1996: 28, pl. 2, figs. 3–7, text-figs. 30j, 31d (and synonymy therein); Hillebrandt, 2006: 204, pl. LI, figs. 9–14; pl. LII, figs. 1–9; pl. LIII, figs. 1–12; pl. LIV, figs. 1–10; pl. LV, figs. 1–22; pl. LIX, figs. 1–12, 15–18 (and synonymy therein); Caruthers and Smith, 2012: 372, pl. 1, figs. 1–6.

Material examined.—Sixteen well-preserved specimens were recovered: eleven from localities 12 and 13, Westgate Ridge Section; three from locality 13, Westgate North Section; one from locality 5, New York Canyon Entrance Section; and one from locality 2, New York Canyon type II Section; see Appendix 2.

Occurrence and age.—*Fanninoceras* (*Fanninoceras*) *carlottense* occurs in the uppermost Pliensbachian from many areas of the eastern Panthalassa Ocean including Argentina (Blasco *et al.*, 1978; Hillebrandt, 2006), Chile (Hillebrandt, 1981, 2006; Perez, 1982), Nevada (Smith and Tipper, 1986; Smith *et al.*, 1988), Oregon (Imlay, 1968; Smith *et al.*, 1988), British Columbia (Haida Gwaii; Smith and Tipper, 1996), and Alaska (Talkeetna Mountains; Caruthers and Smith, 2012). In western North America, *Fanninoceras* (*Fanninoceras*) *carlottense* is used as the zonal index species of the Carlottense Zone.

Description.—A highly involute, rapidly expanding form with a compressed whorl section, acute venter, and tight umbilicus

(UMPC 15043; Table 1). Primary ribs are widely spaced and slightly flexuous on the inner whorls, becoming faint and disappearing early in ontogeny.

Remarks.—*Fanninoceras* (*Fanninoceras*) *carlottense*, which is dealt with in detail by Smith and Tipper (1996) and Hillebrandt (2006), is known to be the most involute and stratigraphically highest ranging species of *Fanninoceras*. It is characterized primarily by its tight volution and compressed whorl shape.

Fanninoceras* (*Fanninoceras*) *fannini McLearn, 1930
Plate 2, figures 1–6

cf. *Fanninoceras fannini* McLearn, 1930: 4, pl. 1, fig. 3.
cf. *Fanninoceras* (*Fanninoceras*) *fannini.* Smith and Tipper, 1996: 29, pl. 3, figs. 1–12, pl. 5, figs. 1, 2, text-figs. 27, 30d–e, 31a–c (and synonymy therein); Hillebrandt, 2006: 199, pl. XLVII, figs. 6, 7, pl. XLVIII, figs. 1, 2, pl. XLIX, figs. 1–3, pl. L, figs. 1, 4–10 (and synonymy therein); Caruthers and Smith, 2012: 372, pl. 1, figs. 7–19.

Material examined.—Ten fragmentary and whole specimens in total: nine from localities 2, 4, 12, 13, Westgate North Section; and one from locality 4, New York Canyon type VI Section; see Appendix 2.

Occurrence and age.—*Fanninoceras* (*Fanninoceras*) *fannini* is known to occur throughout the upper Pliensbachian, mostly reported from the Kunae Zone with rare occurrences in the Carlottense Zone (Smith and Tipper, 1996). Geographically, *Fanninoceras* (*Fanninoceras*) *fannini* is widely distributed throughout the eastern Panthalassa Ocean and is reported from South America (Hillebrandt, 1987; 2006), Oregon (Smith *et al.*, 1988), British Columbia (Haida Gwaii; Frebold, 1964a; Smith *et al.*, 1988; Smith and Tipper, 1996), and Alaska (Talkeetna Mountains; Caruthers and Smith, 2012). In Nevada, *Fanninoceras* (*Fanninoceras*) *fannini* occurs in the Kunae and lowest part of the Carlottense zones.

Description.—Involute with compressed whorls (UMPC 15058; Table 1), acute venter, and rounded umbilical wall. Ribs are strong and prorsiradiate early, and become faint along the upper flank of the outer whorls before projecting gently onto the venter. Shell becomes smooth with growth.

Remarks.—*Fanninoceras* (*Fanninoceras*) *fannini* mostly occurs stratigraphically lower than *Fanninoceras* (*Fanninoceras*) *carlottense* and differs by having a wider whorl section, larger umbilical diameter, and primary ribs that remain relatively strong until a later stage of development.

Fanninoceras* (Fanninoceras)** cf. ***kunae McLearn, 1930
Plate 2, figure 7

cf. *Fanninoceras kunae* McLearn, 1930: 5, pl. 2, fig. 4.
cf. *Fanninoceras* (*Fanninoceras*) *kunae*. Smith and Tipper, 1996: 30, pl. 4, figs. 5–8, 11, 12, text-fig. 30g (and synonymy therein); Shirmohammad *et al.*, 2011: pl. 1, fig. 2.

Material examined.—One poorly-preserved specimen from locality 3, New York Canyon type IV Section; see Appendix 2.

Occurrence and age.—*Fanninoceras* (*Fanninoceras*) *kunae* is restricted to the lower part of the upper Pliensbachian in the eastern Panthalassa Ocean where it is used as the zonal index of the Kunae Zone in North America (Smith *et al.*, 1988). It is reported from Oregon (Imlay, 1968; Smith *et al.*, 1988), British Columbia (Haida Gwaii; Smith *et al.*, 1988; Smith and Tipper, 1996), and Alaska (Talkeetna Mountains; Imlay, 1981). In Nevada, our specimen was collected from the Kunae Zone, just below the first occurrence of *F. carlottense*.

Description.—Involute with compressed whorls, acute venter, and rounded umbilical wall. Flexuous ribs are coarser along the upper flank and project strongly onto the venter.

Remarks.—*Fanninoceras* (*Fanninoceras*) *kunae* and *Fanninoceras* (*Fanninoceras*) *fannini* are noted by Smith and Tipper (1996, p. 30) to have similar volutions and age ranges, differing primarily in rib density and strength, with *Fanninoceras* (*Fanninoceras*) *kunae* having sharper, more densely spaced ribs that project onto the venter. Ribs of *Fanninoceras* (*Fanninoceras*) *fannini* are weak on the lower flank. Recovery of only a single poorly-preserved specimen precludes a positive identification.

Subgenus ***CHARLOTTICERAS*** Smith and Tipper, 1996

Type species.—*Fanninoceras* (*Charlotticeras*) *carteri* Smith and Tipper, 1996.

Fanninoceras (Charlotticeras) aff. ***maudense*** Smith and Tipper, 1996
Plate 2, figure 8

aff. *Fanninoceras* (*Charlotticeras*) *maudense* Smith and Tipper , 1996: 32, pl. 6, figs. 6–11, text-figs. 30a–b.
aff. *Fanninoceras* (*Charlotticeras*) cf. *maudense*. Caruthers and Smith, 2012: 372, pl. 1, figs. 20–22.

Material examined.—One well-preserved float specimen from locality 9, New York Canyon type V Section; see Appendix 2.

Occurrence and age.—Reported from the lower part of the upper Pliensbachian (Kunae Zone) of British Columbia (Haida Gwaii; Smith and Tipper, 1996) and Alaska (Talkeetna Mountains; Caruthers and Smith, 2012). Our float specimen from Nevada was found stratigraphically above *Leptaleoceras* cf. *accuratum* and *Fanninoceras* (*Fanninoceras*) *carlottense*, which suggests that it is Carlottense Zone in age.

Description.—A small, involute, rapidly expanding form with compressed whorls, flat flanks, and a tight umbilicus bearing an abrupt vertical wall (UMPC 15063; Table 1). Ribs are strong, flexuous, and densely spaced, often bifurcating near the middle of the flank, becoming faint on the outermost whorl. On the ventral surface the ribs project strongly, forming an incipient keel.

Remarks.—This specimen is placed in the subgenus *Charlotticeras* because of its bifurcate ribbing and incipient keel. *Fanninoceras* (*Charlotticeras*) *maudense* differs from *Fanninoceras* (*Charlotticeras*) *carteri* (the only other species of this subgenus) primarily by its stronger ribbing and wider umbilicus (Smith and Tipper, 1996). While the specimen from Nevada has ornamentation similar to *Fanninoceras* (*Charlotticeras*) *maudense*, it is much more involute than either *Fanninoceras* (*Charlotticeras*) *maudense* or *Fanninoceras* (*Charlotticeras*) *carteri*. More material, however, must be collected before a new species can be confidently established.

Genus ***DUBARICERAS*** Dommergues, Mouterde and Rivas, 1984

Type species.—*Dubariceras dubari* Dommergues, Mouterde and Rivas, 1984.

Dubariceras freboldi Dommergues, Mouterde and Rivas, 1984
Plate 4, figures 1–5

Dubariceras freboldi Dommergues, Mouterde and Rivas, 1984: fig. 3–A3; Smith and Tipper, 1996: 42, pl. 16, figs. 1, 2; text fig. 33e (and synonymy therein).

Material examined.—Thirty-eight well-preserved specimens in total: fifteen from localities 3, 4, New York Canyon type I Section; eleven from locality 6, New York Canyon type V Section; five from localities 2–4, New York Canyon Entrance Section; and seven from locality 3, Westgate Ridge Section; see Appendix 2.

Occurrence and age.—*Dubariceras freboldi* is known from the middle part of the Pliensbachian, and where it is the index species of the Freboldi Zone (Smith *et al.*, 1988). This species is endemic to eastern Panthalassa where it is reported from South America (Hillebrandt, 1981; 1990), Nevada (Smith *et al.*, 1988), Oregon (Smith *et al.*, 1988), British Columbia (southern British Columbia, Smith *et al.*, 1988; Haida Gwaii, Smith *et al.*, 1988; Smith and Tipper, 1996; Spatsizi, Thomson and Smith, 1992), and Alaska (Wrangell Mountains; Imlay, 1981).

Description.—An evolute, rapidly expanding form with compressed whorls, arched venter, and a shallow umbilicus with a rounded wall. Simple, somewhat flexuous, densely spaced ribs project from the umbilicus and terminate at distinct tubercles at the ventrolateral edge.

Remarks.—This species is characterized by its distinctive ornamentation and moderate rate of shell expansion. Whorl height in our material nearly doubles in adjacent whorls, with ribs that also become coarser with growth. *Dubariceras freboldi* is closely related to *D. silviesi*, differing primarily by its sharper, more closely spaced ribs (Smith and Tipper, 1996).

Genus ***METADEROCERAS*** Spath, 1925

Type species.—*Ammonites muticus* d'Orbigny, 1844.

Metaderoceras evolutum (Fucini, 1924)
Plate 4, figures 6–10, 13

Deroceras evolutum Fucini, 1924: 50, pl. 5, fig. 14.
Metaderoceras evolutum (Fucini). Smith and Tipper, 1996: 44, pl. 16, figs. 3–5, 7, pl. 18, fig. 1, text fig. 33b, 34a (and synonymy therein); Rakus and Guex, 2002: 107, pl. 27, figs. 1–3, pl. 28, figs. 1, 2, 4, 6, text fig. 83a–b (and synonymy therein).

Material examined.—Seven well-preserved whole and fragmentary specimens in total: five from locality 2, New York Canyon type I Section; one from locality 1, New York Canyon type V Section; and one from locality 1, New York Canyon type VI Section; see Appendix 2.

Occurrence and age.—*Metaderoceras evolutum* is common throughout the lower Pliensbachian (Jamesoni and Ibex zone equivalents, as referenced in Text-Fig. 3) of the Mediterranean area (Wiedenmayer, 1980; Rivas, 1983), Europe (Dommergues *et al.*, 2000; Rakus and Guex, 2002), South America (*M.* gr. *gemmellaroi evolutum*; Hillebrandt, 2006), Oregon (Smith *et al.*, 1988), and British Columbia (Haida Gwaii, Smith and Tipper, 1996; Spatsizi, Thomson and Smith, 1992). In Nevada it occurs well below the first occurrence of *Dubariceras freboldi* and at the same stratigraphic interval as *Metaderoceras talkeetnaense*, suggesting a Whiteavesi Zone age.

Description.—Evolute with a shallow umbilicus, compressed, nearly quadrate whorls (UMPC 15089; WW 1.10 cm, WH 1.62 cm), rounded flanks, a rounded ventrolateral shoulder, and a flat venter with no keel. Straight primary ribs project across the flank from the umbilicus, where two or three adjacent ribs merge together and terminate at large regularly distributed tubercles along the ventrolateral edge. Rib strength and fasciculation are consistent throughout growth.

Remarks.—*Metaderoceras evolutum* is discussed in detail by Rivas (1983), Thomson and Smith (1992), and Smith and Tipper (1996). It is distinguished from other species within the genus by its low relief ribs along the flank that are joined or bundled at the ventrolateral edge, frequently at large, regularly spaced tubercles. In comparison to *M.* gr. *gemmellaroi* (in Hillebrandt, 2006), our material from Nevada contains whorls that are more compressed with predominantly straight ribs. South American material in Hillebrandt (2006) contains slightly depressed whorls with straight (pl. 25, figs. 4–10) and prorsiradiate (pl. 25, fig. 3) primary ribs.

Metaderoceras cf. ***mouterdi*** (Frebold, 1970)
Plate 4, figures 11, 12

cf. 1970. *Crucilobiceras mouterdei* Frebold - Frebold, p. 437, pl. 1, fig. 2.
cf. 1996. *Metaderoceras mouterdei* (Frebold) - Smith and Tipper, p. 44, pl. 19, fig. 3 (and synonymy therein).

Material examined.—Two fragmentary specimens in total: one from locality 2, Westgate Ridge Section; and one from locality 2, New York Canyon type VI Section; see Appendix 2.

Occurrence and age.—This species is restricted to the Whiteavesi Zone of British Columbia (Smith *et al.*, 1988; Smith and Tipper, 1996). Our float material from Nevada was found in close stratigraphic proximity to *Acanthopleuroceras whiteavesi* at the base of the Westgate Ridge and New York Canyon sections, and is therefore most likely Whiteavesi Zone in age.

Description.—Evolute with depressed whorls, wide umbilicus with a rounded umbilical edge, and a flat venter bearing no keel. Coarse, regularly spaced ribs project from the umbilicus, becoming more pronounced on the upper flank, terminating at large tubercles along the ventrolateral edge.

Remarks.—*Metaderoceras mouterdei*, which is discussed in detail by Smith and Tipper (1996), is similar to *M. venarense* from the Tethys region. *Metaderoceras mouterdei* is distinguishable primarily by its depressed whorl shape, broad venter, and large tubercles on the ventrolateral shoulder. In comparison to *M. talkeetnaense*, the whorls of *M. mouterdei* are more depressed and its ribs are often not as strong.

Metaderoceras talkeetnaense Thomson and Smith, 1992
Plate 4, figures 14–16; Plate 5, figure 1

Metaderoceras talkeetnaense Thomson and Smith, 1992: p. 20, pl. 6, fig. 1, pl. 7, figs. 1–5; Smith and Tipper, 1996: 45, pl. 17, figs. 2, 3, text-figs. 33a, 34c (and synonymy therein).

Material examined.—Thirty-four whole and fragmentary specimens in total: fifteen from localities 1, 3–5, New York Canyon type I Section; one from locality 4, New York Canyon type V Section; seventeen from localities 1 and 2, New York Canyon type VI Section; and one from locality 1, New York Canyon Entrance Section; see Appendix 2.

Occurrence and age.—This species is reported from the lower part of the Pliensbachian of Argentina (Hillebrandt, 1987, 1990), British Columbia (Haida Gwaii, Smith and Tipper, 1996; Spatsizi, Thomson and Smith, 1992), and Alaska (Talkeetna Mountains; Imlay, 1981). In Nevada, most specimens occur stratigraphically close to *Acanthopleuroceras* cf. *whiteavesi* and in one instance (UMPC 15103) occurs together with *Dubariceras freboldi*, which suggests that *M. talkeetnaense* spanned the Whiteavesi to lowermost Freboldi zones.

Description.—Evolute and slowly expanding, with compressed whorls, rounded umbilical edge, and a flat venter bearing no keel. Regularly spaced, coarse, striate ribs project along the flank and terminate at tubercles along the ventrolateral edge.

Remarks.—*Metaderoceras talkeetnaense* is distinguished from other species of the genus by its coarse, regularly spaced primary ribs that extend completely across the flank and terminate at ventrolateral tubercles. In comparison with *Metaderoceras mouterdei*, *M. talkeetnaense* has a more compressed whorl shape, with ribs that remain coarse and widely spaced near the umbilical wall.

Family **DACTYLIOCERATIDAE** Hyatt, 1867
Subfamily **REYNESOCOELOCERATINAE**
Dommergues, 1986
Genus **REYNESOCOELOCERAS** Géczy, 1976

Type species.—*Ammonites* (*Stephanoceras*) *crassus* Young and Bird var. *indunensis* Meneghini (Meneghini, 1881).

Reynesocoeloceras mortilleti (Meneghini, 1875)
Plate 5, figure 2

Ammonites (*Stephanoceras*) *mortilleti* Meneghini, 1875: appendix, 21, pl. 4, fig. 7; Meneghini, 1876: appendix, 21, pl. 6, figs. 1, 2.
Reynesocoeloceras mortilleti (Meneghini). Smith and Tipper, 1996: 49, pl. 12, figs. 3, 4, 7, 8; text-figs. 26f, 35a–c (and synonymy therein).
Reynesoceras americanum Hillebrandt, 2006: 225, pl. 58, figs. 3, 4, pl. 60, fig. 3, text-fig. 37 (and synonymy therein).
"*Reynesoceras"* aff. *mortilleti*. Meister *et al.*, 2017: 118, fig. 14.

Material examined.—Four fragmentary specimens in total (one of which is a negative impression): two from localities 8, 10, New York Canyon type V Section; and two from locality 7, Westgate Ridge Section; see Appendix 2.

Occurrence and age.—*Reynesocoeloceras mortilleti* ranges from the lower to upper Pliensbachian in the Mediterranean region (Meneghini, 1875; Fucini, 1901a; 1905; 1908; Pinna and Levi-Setti, 1971; Wiedenmayer, 1977; Braga, 1983). In South and North America it has only been found in the upper Pliensbachian from Chile (Hillebrandt, 1981; 1987; 2006), Oregon (Imlay, 1968), and British Columbia (Haida Gwaii; Smith and Tipper, 1996). In Nevada at Westgate, specimens of *Reynesocoeloceras mortilleti* occur within the Kunae Zone, and in the New York Canyon type area Section V this species was found as float, probably from the Carlottense Zone.

Description.—Slightly depressed, evolute shell (UMPC 15108; Table 1), with a rounded whorl, subdued umbilical edge, and a rounded venter. Straight, densely spaced ribs project from the umbilicus and bifurcate frequently at elongated tubercles along the mid to upper part of the flank.

Remarks.—Hillebrandt (2006, p. 227, text-fig. 37) places North American material of *Reynesocoeloceras mortilleti* in synonymy with *Reynesoceras americanum* on the basis of similarities in suture line. Howarth (2013), however, separates the two genera based on morphological differences, noting that *Reynesocoeloceras* has depressed whorls with a flat venter and ribs that bifurcate at tubercles along the ventrolateral edge. This differs from *Reynesoceras*, which displays coarse, single ribs that cross the venter without bifurcation or tubercles (Howarth, 2013, p. 64). Smith and Tipper (1996) maintain a similar separation of the genera (as with Howarth, 2013), noting that the outer whorls of *Reynesocoeloceras* become rounded with shell growth and maintain their rib bifurcation at tubercles, which also distinguishes the genus.

Specimens from Nevada (as well as the majority of other known specimens from western North America) do not display sutures and also do not have clear preservation of internal whorls; therefore, generic distinctions cannot be made on these bases. Specimens do present clear evidence, however, of bifurcating ribs at distinct oblong tubercles on the mid to upper flank. Consequently, we feel that *Reynesocoeloceras* is the appropriate generic assignment for both species based on morphological similarities, and that *R. mortilleti* and *R. americanum* should be synonymized.

Reynesocoeloceras corvalani n. sp.
Plate 5, figures 3–9

Type specimens.—Holotype: UMPC 15112 (Pl. 5, Figs. 8, 9); originally figured by Corvalán (1962, Pl. 3, fig. 1, 2). Paratypes: UMPC 15110 (Pl. 5, Figs. 3–5) and UMPC 15111 (Pl. 5, Figs. 6, 7).

Material examined.—Six well-preserved whole and fragmentary specimens in total: four from localities 4, 6, and 13, Westgate Ridge Section; one from locality 7, Westgate North Section; and one from locality 3, New York Canyon type VI Section; see Appendix 2.

Type locality.—Joker Peak Member of the Sunrise Formation, Westgate Ridge Section, Clan Alpine Mountains, Churchill County, Nevada.

Occurrence and age.—This species only occurs in Nevada. At the Westgate Ridge Section, it spans the Kunae and Carlottense zones of the upper Pliensbachian.

Diagnosis.—This species of *Reynesocoeloceras* is characterized by the highly depressed whorl that maintains a wide venter throughout growth. Ribs are coarse and widely spaced, with large tubercles on the inner whorls that become dense and evenly spaced along the flanks of the outer whorls. Ribs bifurcate at subdued tubercles on the ventral shoulder.

Description.—Evolute and slowly expanding, with a shallow umbilicus and a depressed, coronate whorl section (UMPC 15112; Table 1). Coarse, widely spaced, prorsiradiate ribs extend along the flank of the inner whorls (Pl. 5, Figs. 5, 7), frequently bifurcating at distinct tubercles on the ventrolateral shoulder. Ribs become more densely spaced and wiry across the flanks of the outermost whorls.

Etymology.—This species is named in honour of the late Dr. José Corvalán (1929-1996), who provided the original lithostratigraphic framework for the Westgate District, Clan Alpine Mountains.

Remarks.—This North American form is placed into genus

Reynesocoeloceras because of the depressed inner whorls bearing coarse ribs that bifurcate at large tubercles on the ventral shoulder. This differs from similar genera including: *Bettoniceras*, *Reynesoceras*, and *Aveyroniceras* (*Aveyroniceras* is considered a macroconch of *Reynesoceras* by Howarth, 2013), which have well-rounded whorls bearing single ribs that cross the venter without bifurcation or tubercles; *Prodactylioceras*, which has a less depressed (more circular) whorl, with large widely spaced tubercles at mid-flank; and *Cetonoceras*, which has a depressed inner whorl that becomes more compressed with growth (Howarth, 2013, p. 63–64). In comparison with *Reynesocoeloceras mortilleti* (in Smith and Tipper, 1996, and synonymized material in Hillebrandt, 2006), our specimens from Nevada possess a venter that is too broad and whorl sections that are much more depressed on the outer whorls, which warrants its separation.

Genus ***PRODACTYLIOCERAS*** Spath, 1923

Type species.—*Ammonites davoei* Sowerby, 1822.

Prodactylioceras cf. ***davoei*** (Sowerby, 1822)
Plate 6, figures 1, 2

cf. *Ammonites davoei* Sowerby, 1822: pl. 350.
cf. *Prodactylioceras davoei* (Sowerby). Géczy, 1976: pl. 27, figs. 3, 4; Dommergues *et al.*, 1983: pl. 2, figs. 11–14; Meister, 1986: pl. 18, fig. 8; pl. 19, figs. 3, 7; Dommergues and Meister, 1990: 637, fig. 3(8), 639, fig. 5(9); Schlatter, 1991: pl. 21, figs. 1, 2; Meister and Böhm, 1993: pl. 7, figs. 8, 10; Cassel, 1997: pl. 11, fig. 1; Dommergues *et al.*, 1997: 116, pl. 7, fig. 17.
Prodactylioceras aff. *davoei* (Sowerby). Smith *et al.*, 1988: 1510, pl. 3, fig. 4; this specimen is refigured herein, Pl. 6, Figs. 1, 2.

Material examined.—Three whole and fragmentary specimens in total: two from locality 5, Westgate Ridge Section; and one from locality 8, Westgate North Section; see Appendix 2.

Occurrence and age.—*Prodactylioceras davoei* is a geographically widespread species that ranges from the lower to upper Pliensbachian in Europe, Turkey, and Nevada (Smith *et al.*, 1988; Howarth, 2013). In Europe, *Prodactylioceras davoei* is the zonal index species of the lower Pliensbachian Davoei Zone. In Nevada, it is found in the Kunae Zone at the Westgate North and Ridge sections.

Description.—Evolute, slowly expanding shell with a depressed whorl (UMPC 15115; Table 1), rounded flanks, and a venter bearing no keel. Coarse, densely spaced ribs that project prorsiradiately from the shallow umbilicus bifurcate (only) at large, regularly spaced tubercles at mid- to three-quarters flank on the outermost whorl. Tubercles on the inner whorls appear higher on the flank occurring at the ventrolateral edge. Rib density and coarseness are consistent throughout growth.

Remarks.—This species is characterized by its whorl shape, rib characteristics, and large, regularly spaced tubercles (Howarth, 2013). These characteristics are observed in our specimen from Nevada, but the collection is small and preservation is poor, which prevents a positive identification. *Prodactylioceras* differs from *Reynesocoeloceras* by its less depressed whorl with larger tubercles at mid- to three-quarters flank. *Prodactylioceras* also exhibits finer, more densely-spaced ribs on the flanks of its inner whorls.

Prodactylioceras westgatenses n. sp.
Plate 6, figures 3, 4

Type specimens.—Holotype: UMPC 15117 (Pl. 6, Figs. 3, 4).

Material examined.—Two fragmentary specimens from localities 4 and 9, Westgate Ridge Section; see Appendix 2.

Type locality.—Joker Peak Member of the Sunrise Formation, Westgate Ridge Section, Clan Alpine Mountains, Churchill County, Nevada.

Occurrence and age.—This species is only known from Nevada. Specimens at the Westgate Ridge Section were found within the upper Pliensbachian Kunae Zone.

Diagnosis.—This species of *Prodactylioceras* is distinguished by the coarse, densely spaced ribs that loop around prominent tubercles on the ventrolateral edge and extend across the venter without bifurcation.

Description.—Evolute, with a depressed whorl section (UMPC 15117; Table 1), a rounded umbilical shoulder, and a broad venter with no keel. Coarse primary ribs are widely spaced along the flank and appear to occasionally loop around very large and prominent bullae on the ventrolateral edge of the inner whorls. Finer, flexuous secondary and tertiary ribs appear between the coarse primaries on the third whorl and disappear quickly by the outermost whorl. Rib density and coarseness become more regular and tubercles are absent on the outermost whorl.

Etymology.—This species is named after its type area, Westgate District, west-central Nevada.

Remarks.—We place this species into the genus *Prodactylioceras* on the basis of its whorl shape, rib density, and the large, regularly spaced tubercles. In comparison with *Prodactylioceras davoei*, *Prodactylioceras westgatenses* n. sp. has a more depressed

whorl, with frequent changes in ornamentation and ribbing throughout ontogeny.

Genus ***CETONOCERAS*** Wiedenmayer, 1977

Type species.—*Coeloceras psiloceroides* Fucini, 1905.

***Cetonoceras*?** sp.
Plate 6, figure 5

Dactylioceras commune (Sowerby, 1812–1822). Corvalán, 1962: 182, pl. 2, fig. 8.; this specimen is refigured herein, Pl. 6, Fig. 5.

Material examined.—One specimen, an external mold from locality 21, Westgate Ridge Section; see Appendix 2.

Occurrence and age.—*Cetonoceras* is known from the upper Pliensbachian of Portugal, Spain, France, Italy (references in Howarth, 2013), and British Columbia (Haida Gwaii, Smith and Tipper, 1996). Our specimen from Westgate was found in close stratigraphic proximity to species of *Lioceratoides* and *Protogrammoceras* from the Carlottense Zone.

Description.—Evolute with a compressed whorl and shallow umbilicus with an abrupt shoulder and steep wall. Venter is not present. Straight prorsiradiate ribs project from the umbilicus and bifurcate rarely mid-flank.

Remarks.—In comparison to other dactylioceratids, the whorl section of *Cetonoceras* is not as depressed as in *Reynesocoeloceras*, and is not as round as *Prodactylioceras* or *Reynesoceras*. While our specimen from Nevada does possess characteristics in common with *Cetonoceras* (*e.g.*, whorl shape, steep umbilical wall, and straight to slightly prorsiradiate ribs), we maintain uncertainty with our designation because of the rare rib bifurcation at mid-flank. *Reynesoceras*? sp. in Smith and Tipper (1996, Pl. 18, fig. 4) is probably another representative of this genus (although a different species), which demonstrates the presence of this taxon in at least two areas of western North America (Nevada and Haida Gwaii, British Columbia).

Subfamily **DACTYLIOCERATINAE** Hyatt, 1867
Genus ***REYNESOCERAS*** Spath, 1936

Type species.—*Ammonites ragazzonii* Hauer, 1861.

Reynesoceras colubriforme (Bettoni, 1900)
Plate 7, figures 1, 2

Coeloceras colubriforme Bettoni, 1900: 75, pl. 7, fig. 10.
Aveyroniceras colubriforme (Bettoni). Smith and Tipper, 1986: 401, fig. 2.6 (this specimen is refigured herein, Pl. 7, Figs. 1, 2); Smith *et al.*, 1988: 1510, pl. 3, figs. 5, 6.
Reynesoceras colubriforme (Bettoni). Smith and Tipper, 1996: 46, pl. 17, figs. 4, 5; text-fig. 35b (and synonymy therein).
Prodactylioceras colubriforme (Bettoni). Blau and Meister, 2011: 270, figs. 5g, i, j; Meister *et al.*, 2011: 117, e30, figs. 15.6, 15.9a-c, 15.10; Meister *et al.*, 2017: 116, pl. 10, fig. 7.

Material examined.—One moderately well-preserved fragmentary specimen from locality 6, Westgate Ridge Section; see Appendix 2.

Occurrence and age.—*Reynesoceras colubriforme* is common in the lower to upper Pliensbachian from Italy (Wiedenmayer, 1977; Meister *et al.*, 2017), Morocco (Du Dresnay, 1963; Meister *et al.*, 2011), South America (Hillebrandt, 1981), British Columbia (Haida Gwaii; Smith and Tipper, 1996), and Nevada (Smith and Tipper, 1986; Smith *et al.*, 1988). Our specimen from Nevada occurs in the Kunae Zone of the Westgate Ridge Section.

Description.—Evolute and slowly expanding, with a shallow umbilicus and a depressed whorl section showing a rounded venter without a keel. Simple ribs project in a slightly prorsiradiate fashion across the flank and venter of the inner whorls, showing no bifurcation or tubercles. Ribs become more rectiradiate on the outermost whorl (Pl. 7, Fig. 2).

Remarks.—Whorl shape, a lack of tubercles, and straight simple ribs with no bifurcation distinguish this species from others in the family (see discussions above). According to Howarth (2013), *Reynesoceras* is distinguished from *Prodactylioceras* by its lack of large and distinct tubercles along the flank, and from *Cetonoceras* by having a more rounded, less compressed whorl. Our material from Nevada does not display tubercles and therefore we cannot follow Meister *et al.* (2011, 2017) who placed this species into *Prodactylioceras*. According to Smith and Tipper (1996), this species is distinguished from *R. acanthoides* by the narrow venter on early whorls that becomes comparatively less rounded with growth. Also, ribs of *R. colubriforme* are more rounded and less dense than those in *R. italicum* and *R. acanthoides*.

Reynesoceras italicum (Fucini, 1901a)
Plate 7, figures 3–5

Reynesoceras italicum (Fucini). Smith and Tipper, 1996: 47, pl. 18, fig. 3 (and synonymy therein).
Prodactylioceras italicum (Fucini). Géczy and Meister, 1998: 104, pl. VI, figs. 9, 11, 12.
Prodactylioceras italicum (Fucini). Meister *et al.*, 2011: E28, fig. 17 (3); Shirmohammad *et al.*, 2011: pl. 1, fig. 10; Meister *et al.*, 2017: 114, pl. 11, figs. 2, 8, 16.
Prodactylioceras italicum italicum (Fucini). Blau and Meister, 2011: 272, fig. 5k; Meister and Blau, 2014: 260, figs. 4g, h.

Material examined.—Fourteen moderately well-preserved fragmentary and flattened specimens in total: seven from localities 7–10, Westgate Ridge Section; and seven from localities 1, 2, 7, and 9, Westgate North Section; see Appendix 2.

Occurrence and age.—A geographically widespread species that is reported from the lower to upper Pliensbachian of Europe and the Mediterranean Tethys (Wiedenmayer, 1980; Meister and Blau, 2014; Meister *et al.*, 2011; 2017), Japan (Hirano, 1971), Oregon (Imlay, 1968; Smith, 1981), British Columbia (Haida Gwaii; Smith and Tipper, 1996; Tulsequah, Smith *et al.*, 1988), Alaska (Wrangell Mountains; Imlay, 1981), and the Yukon (Frebold, 1970). Our material from Westgate occurs within the upper Pliensbachian (Kunae Zone).

Description.—Evolute and slowly expanding, with a shallow umbilicus and a circular whorl section with a rounded, keelless venter. Simple, straight ribs project from the rounded umbilical wall, crossing the flanks and venter, showing no bifurcation or tubercles.

Remarks.—*Reynesoceras* is similar to *Bettoniceras* in terms of its volution, lack of tubercles, and straight simple ribs that do not bifurcate. As with *R. colubriforme*, our material from Nevada does not display features consistent with genus *Prodactylioceras* (*e.g.* Howarth, 2013) and therefore we maintain its assignment into genus *Reynesoceras* (*e.g.*, Smith and Tipper, 1996), as opposed to *Prodactylioceras* (*e.g.*, Meister *et al.*, 2017 and others). At the species level, the rib density of *R. italicum* is higher than in *R. colubriforme*.

Genus ***DACTYLIOCERAS*** Hyatt, 1867

Type species.—*Ammonites communis* Sowerby, 1815.

Subgenus ***ORTHODACTYLITES*** Buckman, 1926

Type species.—*Orthodactylites directum* Buckman, 1926.

Dactylioceras* (*Orthodactylites*) *chilense Hillebrandt and Schmidt-Effing, 1981
Plate 7, figures 6–8

Dactylioceras (*Orthodactylites*) *tenuicostatum chilense* Hillebrandt and Schmidt-Effing, 1981: 39, pl. 2, figs. 6-8.

Material examined.—Seven moderately well-preserved fragmentary specimens total: four from localities 41, 47, Westgate Ridge Section; one from locality 32, Westgate North Section; and two from localities 7, 9, New York Canyon Entrance Section; see Appendix 2.

Occurrence and age.—To date, *Dactylioceras chilense* has only been described from the lower Toarcian of Chile (Hillebrandt and Schmidt-Effing, 1981) and now Nevada, where it was found *in situ* and as float in the Westgate and New York Canyon areas in the Kanense Zone.

Description.—Evolute with a depressed circular inner whorl that becomes less depressed and more ellipsoidal with growth. Wiry, thin, and flexuous ribs are densely spaced along the flank and project from the shallow (and wide) umbilicus, occasionally bifurcating at irregularly spaced tubercles on the middle part of the flank (UMPC 15135; Table 1).

Remarks.—We elevate the subspecies *Dactylioceras tenuicostatum chilense* to the rank of species as *Dactylioceras chilense*, based on differences in whorl shape and ribbing between the two species. The ellipsoidal outer whorl shape and fine ribbing of *Dactylioceras chilense* is consistent with *Dactylioceras tenuicostatum* (Howarth, 1973); however, the change in whorl shape in *D. chilense* from depressed circular inner whorls to compressed ellipsoidal outer whorls, as well as the bifurcation of ribs at tubercles along the middle part of the flank, distinguish this species and therefore warrant its separation. A subspecies designation is classically used to designate a geographically-restricted incipient species. The now evidently wider distribution of *D. chilense* in the eastern Pacific is further reason to elevate this form to the species level.

Dactylioceras* (*Orthodactylites*)** cf. ***helianthoides Yokoyama, 1904
Plate 8, figures 1, 2

cf. *Dactylioceras helianthoides* Yokoyama, 1904: 16, pl. 4, figs. 4–6.
cf. *Dactylioceras* sp. Frebold, 1964b: 11, pl. 5, figs. 7, 8.
cf. *Dactylioceras* (*Dactylioceras*) *helianthoides*. Hirano, 1971: 104, pl. 14, figs. 1–10.
cf. *Nodicoeloceras* sp. Pinna and Levi-Setti, 1971: 108, pl. 5, fig. 3.
cf. *Dactylioceras* (?*Orthodactylites*) *helianthoides.* Hillebrandt and Schmidt-Effing, 1981: 36, pl. 1, figs. 12–18; pl. 2, fig. 4; text-figs. 14, 16e.

Material examined.—One poorly-preserved fragmentary specimen from locality 52, Westgate Ridge Section; see Appendix 2.

Occurrence and age.—This species is reported from the lower Toarcian of Japan (Yokoyama, 1904; Hirano, 1971), the Mediterranean region (Pinna and Levi-Setti, 1971), Chile (Hillebrandt and Schmidt-Effing, 1981), and British Columbia (Tulsequah, Frebold, 1964b). Our material co-occurs with other species of *Dactylioceras* and *Nodicoeloceras* from the Kanense Zone of the Westgate Ridge Section.

Description.—Evolute with a depressed whorl, shallow umbilicus, and rounded venter. Strong, widely-spaced primary ribs project from the umbilicus and appear to bifurcate at sharp tubercles on the ventrolateral shoulder.

Remarks.—The depressed whorl shape, coarse ribbing on the flank, and regular tubercles are consistent with *Dactylioceras* (?*Orthodactylites*) *helianthoides* (Hillebrandt and Schmidt-Effing, 1981, pl. 1, figs. 15, 16). However, poor preservation in our material from Nevada precludes positive identification.

Dactylioceras* (*Orthodactylites*)** cf. ***hoelderi
Hillebrandt and Schmidt-Effing, 1981
Plate 8, figures 3, 4

cf. *Dactylioceras* (*Orthodactylites*) *hoelderi* Hillebrandt and Schmidt-Effing, 1981: 38, pl. 2, figs. 1–3, 5, text-figs. 15, 16h, i.

Material examined.—One poorly preserved specimen from locality 52, Westgate Ridge Section; see Appendix 2.

Occurrence and age.—*Dactylioceras* (*Orthodactylites*) cf. *hoelderi* is described from the lower Toarcian of Chile (Hillebrandt and Schmidt-Effing, 1981), and Alberta (Them *et al.*, 2017). Our specimen from Nevada was collected from the lower Toarcian Kanense Zone.

Description.—Evolute with a depressed circular whorl and rounded venter bearing no keel. Simple ribs are densely spaced across the venter. Umbilicus is obscured.

Remarks.—Whorl shape and general volution are consistent with specimens of *D. hoelderi* in Hillebrandt and Schmidt-Effing (1981); however, the obscured umbilicus in our specimen precludes positive identification.

Dactylioceras* (*Orthodactylites*) *kanense McLearn, 1930
Plate 8, figures 5–7

Dactylioceras kanense McLearn, 1930: 4, pl. 1, fig. 2; Jakobs, 1997: 42, pl. 1, figs. 9–12, 19, 20 (and synonymy therein).
Dactylioceras cf. *kanense*. Shirmohammad *et al.*, 2011: pl. 1, fig. 8.

Material examined.—Two fragmentary specimens in total: one from locality 41, Westgate Ridge Section; and one from locality 5, Westgate South Section; see Appendix 2.

Occurrence and age.—*Dactylioceras* (*Orthodactylites*) *kanense* is a geographically wide-ranging species that is reported from Russia (Dagis, 1968), British Columbia (Haida Gwaii, Nechako, Hazelton, and Spatsizi areas, Jakobs, 1997; and the Tulsequah area; Shirmohammad *et al.*, 2011), Alaska (Talkeetna Mountains; Imlay, 1981; Jakobs, 1997), and Oregon (Imlay, 1968). In North America, *Dactylioceras kanense* is the index species of the basal Toarcian Kanense Zone and co-occurs with *Tiltoniceras* and below *Cleviceras*, *Hildaites*, and *Peronoceras* (Jakobs, 1997), suggesting that it was restricted to the lower part of the Kanense Zone. Our material from Nevada was collected above other species of *Dactylioceras* in the lower Toarcian Kanense Zone.

Description.—Evolute with a depressed sub-circular whorl section, rounded venter bearing no keel, and a shallow umbilicus with a rounded edge. Widely-spaced primary ribs bifurcate irregularly along the flank and project across the venter.

Remarks.—*Dactylioceras* (*Orthodactylites*) *kanense*, as discussed by Jakobs (1997), is distinguished by its small diameter and bifurcation of ribs at different locations on the flank.

Genus ***NODICOELOCERAS*** Buckman, 1926

Type species.—*Ammonites crassoides* Simpson, 1855.

Nodicoeloceras middlegatense n. sp.
Plate 9, figures 5, 6

Type specimens.—Holotype: UMPC 15175 (Pl. 9, Figs. 5, 6).

Material examined.—One moderately well-preserved specimen (holotype) from locality 52, Westgate Ridge Section; see Appendix 2.

Type locality.—Mina Peak Member of the Sunrise Formation, Westgate Ridge Section, Clan Alpine Mountains, Nevada.

Occurrence and age.—This species of *Nodicoeloceras* is only found in Nevada and co-occurs with the genus *Dactylioceras* just below the first occurrence of *Cleviceras* from the lower Toarcian Kanense Zone.

Diagnosis.—This species of *Nodicoeloceras* is distinguished by its ontogenetic change in whorl shape from a quadrate inner whorl to a highly depressed *Coeloceras*-like form bearing a broad venter. Ornamentation on the inner whorls show coarse, well-spaced ribs on the flanks and venter that regularly bifurcate at small tubercles along the ventral shoulder. Ribs become fine across the venter of the outermost whorl.

Description.—Evolute and slowly expanding shell with quadrate inner whorls, a rounded venter bearing no keel, and a moderately deep umbilicus bearing a rounded umbilical shoulder and a steep umbilical wall. The outermost whorl be-

comes highly depressed and *Coeloceras*-like with a broad venter. Coarse, widely spaced, prorsiradiate primary ribs bifurcate regularly at small sharp tubercles along the ventrolateral edge. Ribs become fine as they project across the venter.

Etymology.—This species is named after the geographic region of Middlegate, Nevada, site of the Westgate Ridge Section.

Remarks.—In comparison with *Nodicoeloceras nevadaense* n. sp., this species of *Nodicoeloceras* displays a similar ontogenetic change in whorl shape and width, but differs by its quadrate inner whorls (as opposed to the more depressed rounded inner whorl of *Nodicoeloceras nevadaense* n. sp.) that bear strong, widely spaced, prorsiradiate simple ribs.

Nodicoeloceras nevadaense n. sp.
Plate 8, figures 8–17; Plate 9, figures 1–4

Type specimens.—Holotype: UMPC 15151 (Pl. 8, Figs. 15, 16). Paratypes: UMPC 15145 (Pl. 8, Fig. 8) and UMPC 15146 (Pl. 8, Figs. 9, 10).

Material examined.—Forty-three moderately well-preserved fragmentary and whole specimens in total: thirty from localities 27, 35, 41, 43, 48, 51–53, Westgate Ridge Section; ten from localities 7, 21, 22, 33–35, Westgate North Section; two from localities 5, 6, Westgate South Section; and one from locality 8, New York Canyon Entrance Section; see Appendix 2.

Type locality.—Mina Peak Member of the Sunrise Formation, Westgate Ridge Section, Clan Alpine Mountains, Nevada.

Occurrence and age.—This species of *Nodicoeloceras* is only found in Nevada together with species of *Dactylioceras* from the lower Toarcian Kanense Zone.

Diagnosis.—This species of *Nodicoeloceras* is distinguished by the characteristic ontogenetic change in whorl shape to a highly depressed form with a broad venter. Coarse, widely-spaced ribs extend along the flank of the inner whorls, merging at pronounced tubercles along the ventral shoulder and, with growth, become finer and densely spaced with subdued (or missing) tubercles.

Description.—Evolute with rounded inner whorls that quickly become very depressed and *Coeloceras*-like, with a very broad venter and shallow umbilicus bearing a rounded wall (UMPC 15171; Table 1). Coarse, straight primary ribs are widely spaced on the inner whorls and merge at tubercles on the ventrolateral edge, where they bifurcate and project across the venter. During growth, rib spacing along the flank becomes denser and tubercles become subdued or are missing.

Etymology.—This species is named after the state of Nevada, USA, where it was found.

Remarks.—*Nodicoeloceras nevadaense* n. sp. is characterized by its whorl shape and width. At an early stage of growth, the whorl is rounded and only slightly depressed. During ontogeny, the whorl quickly changes, becoming highly depressed and wide on the outermost whorls (UMPC 15168; Table 1). This unique characteristic forms the basis for the separation of this species. The consistent bifurcation of ribs at nodes or tubercles along the ventrolateral edge warrants its placement into the genus *Nodicoeloceras*. Morphological differences between *N. nevadaense* n. sp. and *N. middlegatense* n. sp. are discussed within remarks for *N. middlegatense*.

Genus ***COLLINA*** Bonarelli, 1893

Type species.—*Collina gemma* Buckman, 1927.

Collina? sp.
Plate 10, figure 1

Material examined.—One poorly preserved specimen from locality 38, Westgate North Section; see Appendix 2.

Occurrence and age.—*Collina* is reported from the upper middle Toarcian Bifrons and Variabilis zones of southern Europe (Parisch and Viale, 1906; Fischer, 1966; Guex, 1972), Siberia (Dagis, 1968; Kalacheva, 1988), South America (Hillebrandt and Schmidt-Effing, 1981; Hillebrandt, 1987), British Columbia (Haida Gwaii; Jakobs, 1997), Yukon (Poulton, 1991), and northern Alaska (Imlay, 1955). Our float specimen from Westgate was found above *Dactylioceras*, *Hildaites*, and *Cleviceras*, which could be indicative of a middle Toarcian age. No specimens, however, were found *in situ* and no other taxa were found at this level.

Description.—Evolute with a depressed whorl and a rounded flank bearing regularly spaced spines that extend above the venter.

Remarks.—The depressed evolute whorl and highly spinose ornamentation along the flank is characteristic of genus *Collina* (in Jakobs, 1997; and others). The poor preservation of our specimen from Nevada, however, justifies uncertainty in the designation.

Family LIPAROCERATIDAE Hyatt, 1867
Genus ***LIPAROCERAS*** Hyatt, 1867

Type species.—Liparoceras bronni Spath, 1938.

Subgenus ***BECHEICERAS*** Trueman, 1918

Type species.—Ammonites bechei Sowerby, 1821.

***Liparoceras* (*Becheiceras*)** sp.
Plate 10, figure 2

Material examined.—One very poorly-preserved fragment from locality 7, Westgate North Section; see Appendix 2.

Occurrence and age.—Liparoceras (*Becheiceras*) is a cosmopolitan subgenus that ranges throughout the lower to upper Pliensbachian (mainly Davoei–Margaritatus Zone equivalents) of northwest Europe, the Mediterranean, Indonesia, South America, and British Columbia (see references in Géczy, 1976; Smith and Tipper, 1996). Our float specimen from Nevada was found above *Fanninoceras* (*Fanninoceras*) *fannini* and *Leptaleoceras* cf. *accuratum* and below *Fanninoceras* (*Fanninoceras*) *carlottense*, and is therefore most probably Kunae Zone in age.

Description.—A poorly preserved involute specimen with an extremely broad venter bearing sharp, regularly spaced tubercles at the ventrolateral edge and coarse ribs that project across the venter.

Remarks.—The highly involute coil with a broad venter and two rows of tubercles distinguish this family; however, a smaller tubercle size and finer ribbing along the flank distinguishes *L.* (*Becheiceras*) from *L.* (*Liparoceras*) (Howarth, 2013). The poor preservation of our specimen, however, precludes a confident identification.

Family HILDOCERATIDAE Hyatt, 1867
Subfamily **ARIETICERATINAE** Howarth, 1955
Genus ***ARIETICERAS*** Seguenza, 1885

Type species.—Ammonites algovianus Oppel, 1862.

Arieticeras cf. ***algovianum*** (Oppel, 1862)
Plate 10, figures 3–6

cf. *Ammonites algovianus* Oppel, 1862: 137.
Arieticeras cf. *algovianum* (Oppel). Smith *et al.*, 1988: 1514, pl. 4, figs. 10, 11 (this specimen is refigured herein, Pl. 10, Figs. 5, 6); Shirmohammad *et al.*, 2011: pl. 1, fig. 3.
cf. *Arieticeras* aff. *algovianum* (Oppel). Smith and Tipper, 1996: 54, pl. 20, figs. 11, 12 (and synonymy therein).
cf. *Arieticeras* gr. *algovianum* (Oppel). Géczy and Meister, 1998: 116, pl. XIV, figs. 4–11; pl. XV, figs. 1–3, 6; Meister *et al.*, 2017: 130, pl. 15, figs. 2, 3, 7, 8 (and synonymy therein).
cf. *Arieticeras* ex. gr. *algovianum* (Oppel). Hillebrandt, 2006: 238, pl. LXI, fig. 11; pl. LXIV, figs. 12–14.

Material examined.—Six moderately well-preserved fragmentary specimens in total: three from localities 11, 13, Westgate Ridge Section; and two from localities 10, 13, Westgate North Section; see Appendix 2.

Occurrence and age.—Arieticeras cf. *algovianum* is restricted to the upper Pliensbachian of the Mediterranean region (Oppel, 1862; Wiedenmayer, 1977; Meister *et al.*, 2011; 2017), British Columbia (Haida Gwaii, Smith and Tipper, 1996; Spatsizi, Frebold, 1964b; 1970; Thomson and Smith, 1992; Tulsequah, Frebold, 1964b), and Alaska (Talkeetna Mountains; Imlay, 1981). Our material from Westgate was found just below and along with *Fanninoceras carlottense*, indicating an uppermost Kunae Zone to basal Carlottense Zone age.

Description.—Evolute with a compressed quadrate whorl, prominent keel, and large shallow umbilicus (UMPC 15179; Table 1) bearing a rounded shoulder. Coarse, simple to slightly flexuous ribs project along the flank and gently onto the venter where they disappear short of the keel. There is no ribbing on the innermost whorls but it appears rapidly after 1 to 1.5 volutions (Pl. 10, figs. 3, 4, 6).

Remarks.—Smith and Tipper (1996) distinguished species of *Arieticeras* by differences in shell expansion rate and sinuosity of ribbing. Our material from Nevada resembles *A. algovianum* with respect to the rib strength and slightly higher rate of expansion in comparison to other species, including *A. domarense*, *A. ruthenense*, and *A. disputabile*.

Genus ***LEPTALEOCERAS*** Buckman, 1918

Type species.—Leptaleoceras leptum Buckman, 1918.

Leptaleoceras cf. ***accuratum*** (Fucini, 1931)
Plate 10, figures 7, 8

aff. *Arieticeras*(*?*) *accuratum* Fucini, 1931: 117, pl. 24, fig. 10.
Arieticeras aff. *accuratum*. Smith and Tipper, 1996: 57, pl. 22, figs. 6, 8, 9 (and synonymy therein).
Leptaleoceras gr. *accuratum* (Fucini). Meister *et al.*, 2017: 132, pl. 15, figs. 11, 16 (and synonymy therein).

Material examined.—Five poorly preserved specimens in total: four from localities 3, 4, Westgate North Section; and one from locality 7, New York Canyon type V Section; see Appendix 2.

Occurrence and age.—*Leptaleoceras accuratum* characterizes the lower upper Pliensbachian in the Tethys and Panthalassa oceans, including Italy, southern France, Spain, southern Switzerland (Fucini, 1931; Wiedenmayer, 1980; Braga, 1983; Meister *et al.*, 2017), British Columbia (Haida Gwaii, Smith and Tipper, 1996; Spatsizi area; Smith *et al.*, 1988; Thomson and Smith, 1992), and Alaska (Wrangell Mountains; Imlay, 1981). Specimens at Westgate and the New York Canyon type area co-occur with *Fanninoceras* (*Fanninoceras*) *fannini* at a stratigraphic interval that is above *Dubariceras freboldi* and well below *Fanninoceras carlottense*, indicating the Kunae Zone.

Description.—Evolute with a compressed whorl, arched venter bearing a keel, and a wide umbilicus with a rounded shoulder (UMPC 15184; WH = 0.84 cm, UD = 0.81 cm). Flexuous and densely spaced ribs extend weakly from the umbilicus, become coarser at three-quarters flank, and project gently onto the venter.

Remarks.—Ribbing of *Leptaleoceras* is generally sharper, more sinuous, and of a higher density along the flank in comparison to *Arieticeras* (Smith and Tipper, 1996). Within *Leptaleoceras*, ribs of *L. accuratum* are less densely spaced than those of *L. ruthenense* (Smith and Tipper, 1996).

Genus ***FONTANELLICERAS*** Vecchia, 1949

Type species.—*Harpoceras fontanellense* Gemmellaro, 1886.

Fontanelliceras sp.
Plate 10, figure 9

Material examined.—One moderately well-preserved fragmentary specimen from locality 14, Westgate North Section; see Appendix 2.

Occurrence and age.—*Fontanelliceras* has been described from the upper Pliensbachian and lowermost Toarcian of Italy (Fucini, 1931; Cantaluppi and Brambilla, 1968; Fantini Sestini, 1977; Meister *et al.*, 2017), southern Switzerland (Wiedenmayer, 1980), Spain (Braga *et al.*, 1982; Braga, 1983), France (Monestier, 1934), Morocco (Guex, 1973a), Japan (Hirano, 1971), South America (Hillebrandt, 2006), Oregon (Imlay, 1968), British Columbia (Haida Gwaii; Smith and Tipper, 1996), and Alaska (Talkeetna Mountains; Imlay, 1981). Our specimen occurs just above *Fanninoceras* (*Fanninoceras*) *carlottense* at Westgate, and is well below the first *Dactylioceras*, which indicates a Carlottense Zone age.

Description.—Evolute and slowly expanding shell, with a circular to slightly compressed whorl section, rounded flanks, and a shallow umbilicus with a rounded umbilical wall. The venter is missing on this specimen. Strong, rounded, simple ribs are regularly spaced along the flank, projecting from the base of the umbilical wall.

Remarks.—*Fontanelliceras* is distinguished by its evolute, slowly expanding coil, depressed and nearly quadrate whorl section bearing a sulcate keel, and strong, simple ribs (Smith and Tipper, 1996). Our specimen is missing the venter, but otherwise clearly shows the characteristics of the genus.

Subfamily **PROTOGRAMMOCERATINAE** Mattei, 1974

Genus ***PROTOGRAMMOCERAS*** Spath, 1913

Type species.—*Grammoceras bassanii* Fucini, 1901a.

Subgenus ***PROTOGRAMMOCERAS*** Spath, 1913

Type species.—*Grammoceras bassanii* Fucini, 1901a.

Protogrammoceras* (*Protogrammoceras*) *kurrianum
(Oppel, 1862)
Plate 10, figures 10–13; Plate 11, figures 1–7

Ammonites kurrianus Oppel, 1862: 136, pl. 42, fig. 3.
Protogrammoceras (*Protogrammoceras*) *kurrianum* (Oppel). Howarth, 1992: 60, pl. 3, figs. 3, 4 (and synonymy therein); Smith and Tipper, 1996: 64, pl. 24, figs. 5, 6; text-fig. 39g (and synonymy therein).
Protogrammoceras (*Argutarpites*) cf. *meneghinii* (Bonarelli, 1899). Hillebrandt, 2006: 231, pl. LX, figs. 10–13, pl. LXI, figs. 1–6; pl. LXII, fig. 1; pl. LXIV, figs. 1–11; text-figs. 38a–d.
Fuciniceras (*Paltarpites*) aff. *kurrianus* (Oppel). Meister *et al.*, 2017: 126, pl. 13, fig. 9.

Material examined.—Twenty-nine moderately well-preserved fragmentary and whole specimens in total: twenty specimens from localities 11, 17, 19, 20, 21, 23, 25, 26, 28, 31, 33, 38, 39, 44, 50, Westgate Ridge Section; and nine from localities 7, 16, 24, 28, 29, 30, 31, 35, Westgate North Section; see Appendix 2.

Occurrence and age.—*Protogrammoceras* (*Protogrammoceras*) *kurrianum* is a cosmopolitan species that is found throughout the upper Pliensbachian of Europe (Oppel, 1862; Quenstedt, 1883; Buckman, 1923; Fucini, 1924; Meister *et al.*, 2017), Chile (Hillebrandt, 2006), Oregon (Imlay, 1968), British Columbia (Haida Gwaii, Smith *et al.*, 1988; Smith and Tipper, 1996; Spatsizi, Thomson and Smith, 1992; Tulsequah, Frebold, 1970), Alaska (Talkeetna Mountains, Imlay, 1981), and Alberta (Them *et al.*, 2017). The lowest occurrence at Westgate is just below *Fanninoceras carlottense*,

and the uppermost occurrences are overlapping with species of *Nodicoeloceras* and *Dactylioceras*, thereby indicating an upper Pliensbachian (uppermost Kunae Zone) to lower Toarcian (Kanense Zone) range for the species. These new data effectively extend the range of *P. kurrianum* in western North America into the early Toarcian.

Description.—Evolute to midvolute shell with a compressed oval whorl section (UMPC 15208; up to WW = 3.75 cm, and WH = 5.74 cm), flat or semi-rounded flanks, an arched venter bearing a prominent keel, and a deep umbilicus with a rounded edge and steep walls. Coarse ribs on the innermost whorls quickly become fine, densely spaced, and sinuous, and become flat-topped and faint on the outermost whorls, where they project onto the venter and terminate at the keel.

Remarks.—This species of *Protogrammoceras* was described in detail by Howarth (1992) and Smith and Tipper (1996). It is distinguished from other species in the genus by its fine, densely spaced, flat-topped, sinuous ribs that become faint on the outermost whorls.

Protogrammoceras* (*Protogrammoceras*) *paltum
(Buckman, 1922)
Plate 12, figures 1–4

Paltarpites paltus Buckman, 1922: pl. 362A.
Protogrammoceras (*Protogrammoceras*) cf. *paltum* (Buckman). Smith and Tipper, 1996: 66, pl. 24, figs. 1–4; text-figs. 38k-1, 39b, d, e (and synonymy therein).

Material examined.—Five well to moderately well-preserved whole and fragmentary specimens were collected in total: three from localities 16, 46, Westgate Ridge Section; one from locality 11, Westgate North Section; and one from locality 2, New York Canyon type V Section; see Appendix 2.

Occurrence and age.—*Protogrammoceras* (*Protogrammoceras*) *paltum* is an upper Pliensbachian to lower Toarcian species that has been reported from northern Europe (Buckman, 1922; Howarth, 1992), Oregon (Smith *et al.*, 1988), British Columbia (Haida Gwaii, Smith *et al.*, 1988; Smith and Tipper, 1996; Tulsequah, Smith *et al.*, 1988), Alberta (Them *et al.*, 2017), Alaska (Talkeetna Mountains; Imlay, 1981), and Arctic Canada (Frebold, 1970). In northwest Europe it is restricted to the lower Toarcian where it is the subzonal index species for the basal Toarcian, and in western North America it ranges from the uppermost Pliensbachian to lower Toarcian. Our material from Westgate is consistent with this age range and was found in place in the Carlottense and Kanense zones.

Description.—Evolute shell with a large umbilicus bearing a rounded shoulder, compressed oval whorl, flat flanks, and a shouldered venter bearing a prominent keel section (UMPC 15215; Table 1). Sinuous, rounded ribs extend weakly from the umbilicus, becoming coarser as they cross the flank and projecting strongly onto the venter, terminating short of the keel.

Remarks.—*Protogrammoceras* (*Protogrammoceras*) *paltum*, which is treated in detail by Howarth (1992), is distinguished from *Protogrammoceras kurrianum* by its coarse, sinuous ribs that are rounded (as opposed to flat-topped) and become finer in later growth stages.

Protogrammoceras* (*Protogrammoceras*) cf. *varicostatum
(Fucini, 1900)
Plate 12, figures 5, 6

cf. *Grammoceras varicostatum* Fucini, 1900: 32, pl. 8, fig. 6.
cf. *Protogrammoceras* (*P.*) *varicostatum* (Fucini). Géczy, 1967: 117, pl. 38, fig. 1; Smith, 1981: 308, pl. 18, figs. 4, 5.

Material examined.—One well-preserved fragmentary specimen from locality 2, New York Canyon type IV Section; see Appendix 2.

Occurrence and age.—*Protogrammoceras* (*Protogrammoceras*) *varicostatum* is reported from the Pliensbachian of Italy, Hungary, possibly North Africa, and Oregon (see references in Géczy, 1967; Smith, 1981). Our float specimen from the New York Canyon type Section IV was found below *Fanninoceras* (*Fanninoceras*) *kunae* and above *Dubariceras freboldi* (from Section V), which suggests a possible Freboldi–Kunae zone age range.

Description.—Evolute shell with a compressed whorl section, deep umbilicus bearing a sharp edge and vertical wall, and flat flanks with a marked ventro-lateral shoulder. Rounded, sinuous ribs extend from the umbilicus across the flank, projecting strongly onto the venter and disappearing just short of the keel.

Remarks.—This species differs from *Protogrammoceras paltum* by its deep umbilicus bearing a vertical wall and ribs that are less densely spaced along the flank. In comparison to *Protogrammoceras kurrianum*, ribs of *Protogrammoceras varicostatum* are coarser and more rounded.

Subgenus ***MATTEICERAS*** Wiedenmayer, 1980

Type species.—*Ammonites nitescens* Young and Bird, 1828.

Protogrammoceras* (*Matteiceras*) *tipperi n. sp.
Plate 12, figure 7; Plate 13, figure 1; Plate 14, figure 1

Genus and species indet. Smith and Tipper, 1996: 67, pl. 23, fig. 4.

Type specimens.—Holotype: GSC 99013 (Smith and Tipper (1996), p. 67, pl. 23, fig. 4). Paratypes: UMPC 15224 (Pl. 14, Fig. 1), UMPC 15223 (Pl. 13, Fig. 1), UMPC 15222 (Pl. 12, Fig. 7).

Material examined.—Seven moderately well-preserved fragmentary and whole specimens were collected: six from localities 3–7, Westgate North Section; and one from locality 4, Westgate Ridge Section; see Appendix 2.

Type locality.—Fannin Formation of the Lower Jurassic Maude Group, Section F, Graham Island, Haida Gwaii, British Columbia Canada. Smith and Tipper (1996) assign the holotype specimen, collected as float, to the Kunae Zone based on a co-occurrence with many other float and in place ammonites from the Kunae Zone.

Occurrence and age.—Previously, *Protogrammoceras* (*Matteiceras*) *tipperi* n. sp. has only been described from British Columbia (Haida Gwaii; Smith and Tipper, 1996). In Nevada at the Westgate North Section, *Protogrammoceras* (*Matteiceras*) *tipperi* n. sp. is restricted to the upper Pliensbachian (Kunae Zone), occurring in close proximity to *Fanninoceras* and *Leptaleoceras*.

Diagnosis.—This species of *Protogrammoceras* is distinguished by the prominent, sharp umbilical edge with a straight to nearly vertical wall and the pronounced change in ribbing with growth. Coarse, rounded, straight to gently sinuous ribs cross the flat flanks of the inner whorls, and become fine, sinuous, and flat-topped on the outermost whorl.

Description.—A slowly expanding evolute form with a wide umbilicus, a compressed (oval?) whorl section, relatively flat flanks, and a fastigate venter bearing a keel (UMPC 15223; Table 1). The umbilical shoulder is sharp and the umbilical wall nearly vertical. Ribs are coarse and straight to slightly flexuous on the flanks of the inner whorls and become wider, flat-topped, and sinuous on the outermost whorl (Pl. 14, fig. 1), turning sharply at the ventrolateral shoulder as they project onto the venter.

Etymology.—This species is named in honour of the late Dr. Howard Tipper (1923–2005), paleontologist with the Geological Survey of Canada.

Remarks.—*Protogrammoceras tipperi* n. sp. is similar to *Protogrammoceras varicostatum* with respect to its prominent, nearly vertical umbilical wall, but is distinguished by its straight to gently sinuous ribs on the inner whorls that project across the flank and terminate at the ventrolateral shoulder (Pl. 14, fig. 1). A single specimen from the Westgate North Section shows sinuous ribs on the outermost whorl (Pl. 14, fig. 1), which suggests an ontogenetic change in ribbing upon reaching maturity. Our material occurs over a relatively narrow stratigraphic interval at Westgate, which suggests a possible short age range for the species.

Genus ***LIOCERATOIDES*** Spath, 1919

Type species.—*Lioceras grecoi* Fucini, 1901a.

Subgenus ***LIOCERATOIDES*** Spath, 1919

Type species.—*Lioceras grecoi* Fucini, 1901a.

Lioceratoides* (*Lioceratoides*)** cf. ***allifordense (McLearn, 1930)
Plate 12, figure 13

Harpoceras allifordense McLearn, 1930: 4, pl. 2, fig. 1; McLearn, 1932: 65, pl. 5, figs. 1–3; Frebold, 1964a: 20, pl. 8, fig. 5 (holotype refigured).
Lioceratoides (*Lioceratoides*) *allifordense* (McLearn). Smith and Tipper, 1996: 68, pl. 26, figs. 5, 6, 9–11, text-figs. 39a, s.

Material examined.—Two poorly preserved specimens: one from locality 24, Westgate Ridge Section; and one from locality 28, Westgate North Section; see Appendix 2.

Occurrence and age.—*Lioceratoides* (*Lioceratoides*) *allifordense* has been reported from the upper Pliensbachian to the lowermost Toarcian (Carlottense–Kanense zones) of British Columbia (Haida Gwaii; Smith and Tipper, 1996). Our material from Nevada occurs within the upper Pliensbachian Carlottense Zone from Westgate.

Description.—A midvolute form with a compressed whorl section, flat flanks, and fastigate venter bearing a keel. Regularly spaced, intercalated, flat-topped, falcoid primary and secondary ribs project across the flank and onto the venter.

Remarks.—Smith and Tipper (1996) place this species into the subgenus *Lioceratoides* based on an ontogenetic change in ornamentation and a relatively involute compressed whorl section. In comparison to other species, *Lioceratoides* (*Lioceratoides*) *allifordense* is less involute than *Lioceratoides*

(*Lioceratoides*) *involutum* and has a more compressed shell, with less persistent ribbing in comparison to *Lioceratoides* (*Lioceratoides*) *maurelli*. Poor preservation of collected material precludes positive identification.

Lioceratoides* (*Lioceratoides*)** cf. ***involutum Smith and Tipper, 1996
Plate 12, figures 8–12

cf. *Lioceratoides* (*Lioceratoides*) *involutum* Smith and Tipper, 1996: 69, pl. 26, figs. 2–4; text-fig. 39p.
cf. *Lioceratoides* (*Lioceratoides*) cf. *involutum*. Caruthers and Smith, 2012: 373, pl. 1, figs. 34–36.

Material examined.—Four moderately well-preserved whole and fragmentary specimens were collected from localities 15, 19, 37, 40 at the Westgate Ridge Section; see Appendix 2.

Occurrence and age.—This species was previously only known from the upper Pliensbachian (Carlottense Zone) of British Columbia (Haida Gwaii; Smith and Tipper, 1996) and Alaska (Talkeetna Mountains; Caruthers and Smith, 2012). Occurrences of this species at Westgate, however, overlap with *Dactylioceras* and *Nodicoeloceras*, which extends its range into the lower Toarcian (Kanense Zone). Therefore, *Lioceratoides* (*Lioceratoides*) *involutum* ranged from the upper Pliensbachian (Carlottense Zone) to the lower Toarcian (Kanense Zone).

Description.—Involute shell with a compressed, ellipsoidal whorl section, slightly rounded flanks, arched venter bearing a small keel, and a deep umbilicus with a rounded edge and a near vertical wall. Weak, densely spaced, sinuous ribs project from the umbilicus and become slightly more prominent along the flank before projecting onto the venter towards the keel.

Remarks.—*Lioceratoides* (*Lioceratoides*) *involutum* is the most involute species of the genus known in North America; it has a higher rib density than *Lioceratoides* (*Lioceratoides*) *allifordense* and *Lioceratoides* (*Lioceratoides*) *maurelli* (see Smith and Tipper, 1996). Poor preservation of recovered material at Westgate prevents a confident identification.

Lioceratoides* (*Lioceratoides*) *maurelli McLearn, 1930
Plate 15, figures 1–3

cf. *Harpoceras maurelli* McLearn, 1930: 4, pl. 1; McLearn, 1932: 63, pl. 7, figs. 4–6.
cf. *Lioceratoides* (*Lioceratoides*) *maurelli* (McLearn). Smith and Tipper, 1996: 69, pl. 26, fig. 1.

Material examined.—Seven well- to moderately well-preserved whole and fragmentary specimens were collected from localities 18, 21, 22, and 32, Westgate Ridge Section; see Appendix 2.

Occurrence and age.—This species was previously only known from an undifferentiated Pliensbachian—Toarcian interval from Haida Gwaii, British Columbia (see Smith and Tipper, 1996 for discussion). Our material from Nevada occurs well above *Fanninoceras carlottense* and just below the first *Dactylioceras*, which suggests a latest Pliensbachian Carlottense Zone age.

Description.—Midvolute shell with a moderately deep umbilicus, compressed ellipsoidal whorl, flat flanks, and fastigate venter bearing a tall keel (UMPC 15236; Table 1). Sinuous, flat-topped, intercalated primary and secondary ribs extend along the flank and project strongly onto the venter, reaching the keel. Ribs remain coarse throughout ontogeny and into larger shell diameters.

Remarks.—Smith and Tipper (1996) place this species into subgenus *Lioceratoides* based on the volution, compressed whorl shape, and distinctive ornamentation. *Lioceratoides* (*Lioceratoides*) *maurelli* has stronger ribs than *Lioceratoides* (*Lioceratoides*) *allifordense* and is less involute than *Lioceratoides* (*Lioceratoides*) *involutum*. Our material from Nevada resembles the type specimens of McLearn (1930, 1932; refigured in Smith and Tipper, 1996) with respect to ribbing, shell diameter, umbilical diameter, and whorl height.

Subgenus ***PACIFICERAS*** Repin, 1970

Type species.—*Schloenbachia propinqua* Whiteaves, 1884.

Lioceratoides* (*Pacificeras*) *angionus (Fucini, 1931)
Plate 15, figure 9

Praelioceras angionum Fucini, 1931: 107, pl. 12, figs. 1–5.
Lioceratoides angionus (Fucini). Guex, 1973a: 507, pl. 1, fig. 5.
Lioceratoides (*Pacificeras*) *angionus* (Fucini). Smith and Tipper, 1996: 71, pl. 27, figs. 3–7.

Material examined.—One well-preserved whole specimen from locality 42, Westgate Ridge Section; see Appendix 2.
Occurrence and age.—*Lioceratoides* (*Pacificeras*) *angionus* has been described from the upper Pliensbachian to lowest Toarcian of Italy (Fucini, 1931), Morocco (Guex, 1973a), and British Columbia (Haida Gwaii; Smith and Tipper, 1996). Our specimen from Nevada occurs along with *Dactylioceras* (*Orthodactylites*) *kanense* at Westgate, which indicates the earliest Toarcian (Kanense Zone).

Description.—Midvolute shell with a sub-circular or semi-quadrate whorl section, flat to slightly rounded (convex) flanks, tabulate venter bearing a small keel, and a deep umbilicus with a rounded edge and near vertical wall (UMPC 15241; Table 1). Ribs are swollen on the innermost whorl and quickly become sinuous, flat-topped, and fine as they project from the base of the umbilicus on the inner whorls, disappearing entirely by the outermost whorl (~2.5 volutions).

Remarks.—This species is placed into the subgenus *Pacificeras* because of its evolute coil, whorl section bearing convex flanks, rounded umbilical edge with a prominent umbilical wall, and rapid ontogenetic change in ribbing. *Lioceratoides* (*Pacificeras*) *angionus* differs from *Lioceratoides* (*Pacificeras*) *propinquum* by its whorl shape. *Lioceratoides* (*Pacificeras*) *angionus* has almost parallel flanks, a deeper umbilicus with a near vertical wall, and tabulate venter (Smith and Tipper, 1996).

Lioceratoides* (*Pacificeras*) *propinquum (Whiteaves, 1884)
Plate 15, figures 4–8, 10–16

Schloenbachia propinqua Whiteaves, 1884: 247.
Lioceratoides (*Pacificeras*) *propinquum* (Whiteaves). Smith and Tipper, 1996: 71, pl. 28, figs. 1–11, pl. 29, fig. 1, text-figs. 38d–g, 39n, q (and synonymy therein); Shirmohammad *et al.*, 2011: pl. 1, fig. 6.

Material examined.—Eighty-six well-preserved whole and fragmentary specimens were collected: 58 from localities 17, 19, 20, 23–25, 29, 30, 32–34, 42, 43, 45, and 47, Westgate Ridge Section; 26 from localities 10, 13, 16–20, 23, 25–29, and 34, Westgate North Section; one from locality 2, Westgate South Section; and one from locality 6, New York Canyon Entrance Section; see Appendix 2.

Occurrence and age.—Only reported from the upper Pliensbachian to lower Toarcian of eastern Panthalassa in British Columbia (Haida Gwaii, see discussion in Smith and Tipper, 1996, p. 72 regarding Russian material figured in Howarth, 1992). Specimens from Nevada were found spanning the Carlottense to Kanense Zones and therefore have a similar age range.

Description.—Midvolute shell with a shallow umbilicus bearing a rounded umbilical edge, a compressed whorl section, flat to gently rounded flanks, and an arched venter bearing a small keel (UMPC 15258; Table 1). Although rib strength is quite variable, primary and secondary ribs are generally coarser, sinuous, flat-topped, and intercalated on the inner whorls, and become fine by ~2.5 or 3 volutions, disappearing entirely by ~3 to 3.5 volutions.

Remarks.—This species is described in detail by Smith and Tipper (1996), who suggested its re-assignment into the subgenus *Pacificeras* based on its midvolute, slowly expanding shell and ontogenetic change in ribbing. It differs from *Lioceratoides* (*Pacificeras*) *angionus* by having a slower rate of shell expansion, a shallower umbilicus, a more rounded and less pronounced umbilical wall, and a somewhat arched (as opposed to tabulate) venter.

Subfamily **HARPOCERATINAE** Neumayr, 1875
Genus ***TILTONICERAS*** Buckman, 1913

Type species.—*Tiltoniceras costatum* Buckman, 1913.

Tiltoniceras antiquum (Wright, 1882)
Plate 16, figures 1–5

Harpoceras antiquum Wright, 1882: 57, figs. 1, 2.
Tiltoniceras antiquum (Wright). Smith and Tipper, 1996: 72, pl. 30, figs. 1–4, text-fig. 391m (and synonymy therein).

Material examined.—Eleven well-preserved whole and fragmentary specimens were collected from localities 19, 47, 49, and 50, Westgate Ridge Section; see Appendix 2.

Occurrence and age.—*Tiltoniceras antiquum* ranges from the uppermost Pliensbachian to the lower Toarcian (Spinatum–Tenuicostatum zone equivalents) of northwest Europe and Russia (Wright, 1882; Denckmann, 1887; Buckman, 1913; Dagis, 1974; Howarth, 1992; and others), British Columbia (Haida Gwaii, Smith and Tipper, 1996; Spatsizi, Thomson and Smith, 1992; Tulsequah, Frebold, 1964b), Yukon (Poulton, 1991) and Alberta (*T.* cf. *antiquum* in Them *et al.*, 2017). Our material from Nevada occurs in the lower Toarcian (Kanense Zone) at Westgate.

Description.—Midvolute shell with compressed, rapidly expanding whorls, flat or gently rounded flanks, arched venter bearing an incipient keel, and a rounded umbilical edge with a subdued wall. Faint, sinuous ribs project along on the flanks of the innermost whorls and disappear quickly by ~1.5 volutions.

Remarks.—*Tiltoniceras* is a monospecific genus. In comparison to *Lioceratoides* (*Pacificeras*) *propinquum*, *Tiltoniceras antiquum* is more involute, has a higher rate of whorl expansion, and has ribs that are finer (less complex) and are not subdivided into primaries and secondaries (Smith and Tipper, 1996).

Genus ***CLEVICERAS*** Howarth, 1992

Type species.—*Ammonites exaratus* Young and Bird, 1828.

Cleviceras exaratum (Young and Bird, 1828)
Plate 16, figures 6–11

Ammonites exaratus Young and Bird, 1828: 266.
Cleviceras exaratum (Young and Bird). Howarth, 1992: 90–99, pl. 9, figs. 2–6, pl. 10, figs. 1–8, pl. 11, figs. 1–17, pl. 12, figs. 1–5, pl. 13, figs. 1, 2 (and synonymy therein).
Cleviceras cf. *exaratum* (Young and Bird). Jakobs, 1997: 50, pl. 3, figs. 6, 7, 12, 13; pl. 4, figs. 3, 4 (and synonymy therein).

Material examined.—Six moderately well-preserved whole and fragmentary specimens were collected: four from locality 37, Westgate North Section; and two from locality 53, Westgate Ridge Section; see Appendix 2.

Occurrence and age.—Cleviceras exaratum is known from the lower to middle Toarcian of northwest Europe (Riegraf *et al.*, 1984; Howarth, 1992), Siberia (Dagis, 1974), Japan (Hirano, 1973a,b), British Columbia (southern Canadian Rockies, Nelson, Haida Gwaii, Spatsizi, Hazelton, Tulsequah, Jakobs, 1997), Alaska (Imlay, 1981; Jakobs, 1997), and Alberta (Them *et al.*, 2017). Our material occurs above *Dactylioceras* and along with the uppermost occurrence of *Nodicoeloceras*, which suggests an age range that possibly spans the early to middle Toarcian (Kanense–Planulata zones).

Description.—Midvolute shell with a sharp umbilical edge and near vertical umbilical wall. It has a compressed oval to ellipsoidal whorl section (UMPC 15293; Table 1), flat flanks, and a shouldered venter bearing a pronounced keel. Coarse, densely spaced, falcoid ribs extend from the prominent umbilical wall across the flank, and project onto the venter. Ribs become faint or disappear entirely just before the keel.

Remarks.—Cleviceras was comprehensively treated by Howarth (1992). It is separated from other hildoceratids based on differences in volution and ornamentation. In comparison to *Protogrammoceras*, species of *Cleviceras* have a more involute shell with falcoid (as opposed to sinuous) ribs; and in comparison to *Harpoceras*, species of *Cleviceras* lack the spiral groove or undulations at mid-flank and do not show the high-angled (falcate) bend in ribbing that occurs at mid-flank in species of *Harpoceras* (Howarth, 1992).

Subfamily **HILDOCERATINAE** Hyatt, 1867
Genus ***HILDAITES*** Buckman, 1921

Type species.—Hildaites subserpentinus Buckman, 1921.

Hildaites cf. ***murleyi*** (Moxon, 1841)
Plate 16, figures 12, 13

cf. *Ammonites murleyii* Moxon, 1841: pl. 24, fig. 6.
cf. *Hildaites murleyii* (Moxon). Howarth, 1992: 168–171, pl. 30, figs. 9, 10, pl. 31, figs. 1–8, pl. 32, fig. 4 (and synonymy therein); Jakobs, 1997: 53, pl. 5, figs. 1–9 (and synonymy therein).

Material examined.—Two poorly preserved fragmentary specimens were collected in total: one from locality 43, Westgate Ridge Section; and one from locality 7, Westgate South Section; see Appendix 2.

Occurrence and age.—Hildaites murleyi is restricted to the upper part of the lower Toarcian of Germany (Schlegelmilch, 1976; Riegraf, 1985), Austria (Fischer, 1966), England (Howarth, 1992), Morocco (Guex, 1973b), Spain (Goy and Martinez, 1990), Siberia (Dagis, 1974), South America (Hillebrandt, 1987), British Columbia (Haida Gwaii, Spatsizi, Cry Lake; Jakobs, 1997), and Alberta (Them *et al.*, 2017). Float specimens from Westgate were found below *Cleviceras* in a similar interval with *Dactylioceras* and *Nodicoeloceras*, suggesting an early Toarcian (Kanense Zone) age.

Description.—Evolute shell with compressed whorls bearing a keel. Sinuous or falcoid-shaped primary ribs are faint on the lower part of the flank and become more pronounced and coarse near the venter, projecting towards the keel.

Remarks.—Although poorly preserved, our material has falcoid ribs that appear faint or subdued on the lower flank and become more pronounced at the ventrolateral edge, distinguishing *Hildaites* from other early Toarcian genera such as *Cleviceras* or *Harpoceras* (as noted in Howarth, 1992 and Jakobs, 1997). Only two poorly preserved specimens were recovered from Westgate, which precludes a positive identification.

SUMMARY

This paper presents the biostratigraphic and systematic description of 408 ammonoids from 10 stratigraphic sections in the Gabbs Valley and Clan Alpine mountain ranges of west-central Nevada (USA). Additionally, zircon $^{206}Pb/^{238}U$ CA-ID-TIMS analysis from an intercalated volcanic ash bed is also presented. These datasets together provide a detailed temporal framework for the Pliensbachian and Toarcian stratigraphy of the Luning Embayment. This framework is important to our understanding of the Jurassic System in terms of: time-scale calibration; depositional timing and stratigraphic correlation across the basin; ammonoid paleobiogeography; and biodiversity changes during a protracted mass extinction.

Ammonoid biostratigraphy of 23 genera and 50 species (five new) indicates the presence of the Whiteavesi, Freboldi, Kunae, and Carlottense zones of the Pliensbachian and the

Kanense Zone of the lower Toarcian. New species include (in alphabetical order): *Nodicoeloceras middlegatense*, *Nodicoeloceras nevadaense*, *Prodactylioceras westgatenses*, *Protogrammoceras* (*Matteiceras*) *tipperi*, and *Reynesocoeloceras corvalani*. A volcanic ash bed within the basal New York Canyon type V section yielded a $^{206}Pb/^{238}U$ CA-ID-TIMS age of 188.98 ± 0.11 Ma from the middle-upper part of the Whiteavesi Zone.

Ammonoids collected from the upper Mina Peak Member indicate new age constraints on the transition between the Sunrise and Dunlap formations. This transition constitutes a major sea level regression in the basin, the timing of which is poorly known. In the Westgate area, the Mina Peak Member is overlain by a ca. 130 m thick argillaceous siltstone and shale sequence that contains rare occurrences of *Cleviceras exaratum* and *Collina*? sp. The presence of these two taxa indicates that deposition of the uppermost Mina Peak Member could have continued into the middle Toarcian, suggesting that the major regressive phase in the Luning Embayment is younger than previously thought.

The diverse ammonoid fauna from the Luning Embayment provides a low-latitude cratonic standard of reference for assessing patterns of Early Jurassic paleobiogeography and terrane displacement. During the Pliensbachian, the Luning Embayment was dominated by taxa that are mostly characteristic of the Mediterranean Tethys (*e.g.*, *Metaderoceras*;, *Reynesocoeloceras*, *Reynesoceras*, and *Lioceratoides*), with a minor presence of taxa common in the northwestern Tethys (*e.g.*, *Acanthopleuroceras* and *Tropidoceras*) and East Pacific (*e.g.*, *Fanninoceras*). This suggests an open Hispanic Corridor, a trans-Pangean seaway linking the Tethys Ocean, European epicontinental seaway, and Panthalassa Ocean. Widely distributed taxa such as *Protogrammoceras*, *Dactylioceras*, *Cleviceras*, and *Collina* became dominant during the latest Pliensbachian and Toarcian, indicating a post-extinction shift from a more endemic to a more cosmopolitan biogeography. The new biostratigraphic framework established here for the Luning Embayment will support subsequent studies aimed at understanding long-term biogeochemical and sedimentological changes, which may be related to the causes and dynamics of the protracted extinction that characterizes the Pliensbachian–Toarcian interval.

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APPENDIX 1: U-PB AGE DATES & ANALYTICAL TECHNIQUES

CA-ID-TIMS procedures that were used to generate U–Pb ages, presented in the text, are modified from Mundil et al. (2004), Mattinson (2005), and Scoates and Friedman (2008). A detailed account of methodologies can be found in Them *et al.* (2017). Unless otherwise noted, all errors are quoted at the 2-sigma or 95% level of confidence. Isotopic dates are calculated with the decay constants λ_{238}=1.55125E-10 and λ_{235}=9.8485E-10 (Jaffey *et al.*, 1971). EARTHTIME U-Pb synthetic solutions are analysed on an on-going basis to monitor the accuracy of results.

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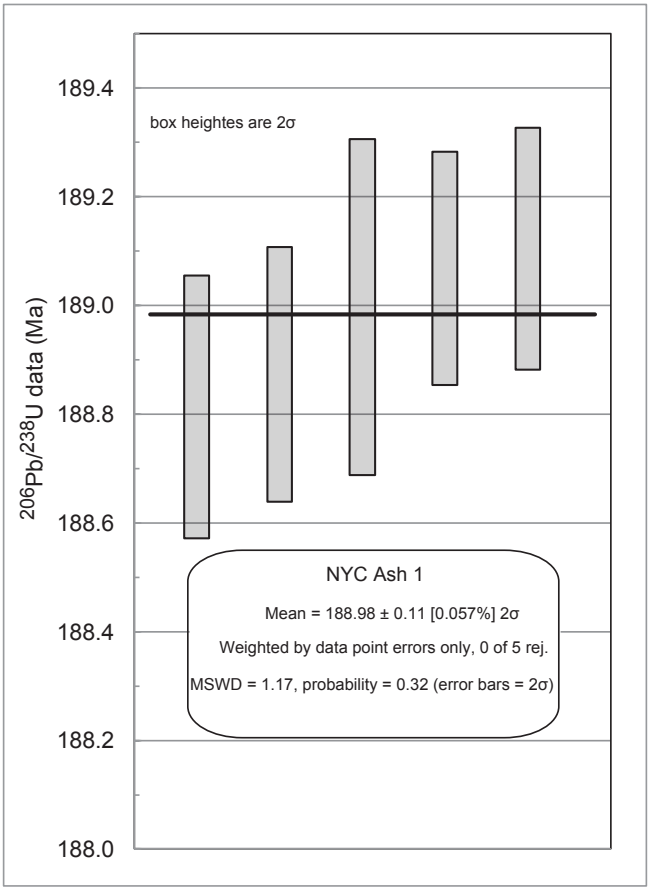

A $^{206}Pb/^{238}U$ age comparison plot of all data analyzed by Chemical Abrasion-Isotope Dilution-Thermal Ionazation mass Spectrometry (CA-ID-TIMS) from New York Canyon, Nevada. Data show a mean age of 188.98 Ma for five zircon crystals analyzed from NYC Ash 1.

Combined U-Th-Pb isotope data for NYC Ash 1. Data obtained by CA-ID-TIMS analysis by the Pacific Centre for Isotopic and Geochemical Research at the University of British Columbia.

U-Th-Pb isotopic data

		Compositional Parameters								Radiogenic Isotope Ratios								Isotopic Ages					
Sample	Wt. mg	U ppm	Pb ppm	Th U	$^{206}Pb^*$ x10^{-13} mol	mol % $^{206}Pb^*$	Pb^* Pb_c	Pb_c (pg)	^{206}Pb ^{204}Pb	^{208}Pb ^{206}Pb	^{207}Pb ^{206}Pb	% err	^{207}Pb ^{235}U	% err	^{206}Pb ^{238}U	% err	corr. coef.	^{207}Pb ^{206}Pb	±	^{207}Pb ^{235}U	±	^{206}Pb ^{238}U	±
(a)	(h)	(i)	(i)	(b)	(c)	(c)	(c)	(c)	(d)	(e)	(e)	(f)	(e)	(f)	(e)	(f)		(g)	(f)	(g)	(f)	(g)	(f)
NYC ASH 1																							
A	0.0072	150	5.0	0.665	1.3289	99.09%	35	1.00	2038	0.212	0.050032	0.346	0.205110	0.399	0.029733	0.128	0.549	196.48	8.04	189.44	0.69	188.88	0.24
B	0.0068	91	3.0	0.548	0.7678	98.59%	22	0.90	1315	0.174	0.049860	0.741	0.204543	0.783	0.029753	0.168	0.348	188.48	17.25	188.96	1.35	189.00	0.31
C	0.0054	156	5.1	0.569	1.0530	98.81%	26	1.04	1561	0.182	0.050044	0.442	0.205379	0.490	0.029765	0.117	0.515	197.05	10.26	189.67	0.85	189.08	0.22
D	0.0085	149	4.8	0.543	1.5779	99.31%	44	0.91	2664	0.173	0.049888	0.324	0.204454	0.372	0.029723	0.132	0.514	189.78	7.54	188.89	0.64	188.82	0.24
E	0.0050	144	4.6	0.501	0.8914	98.95%	28	0.78	1754	0.159	0.049678	0.502	0.203915	0.547	0.029770	0.121	0.464	179.95	11.70	188.43	0.94	189.11	0.23

(a) A, B etc. are labels for fractions composed of single zircon grains or fragments; all fractions annealed and chemically abraded after Mattinson (2005) and Scoates and Friedman (2008).
(b) Model Th/U ratio calculated from radiogenic 208Pb/206Pb ratio and 207Pb/235U age.
(c) Pb* and Pbc represent radiogenic and common Pb, respectively; mol % $^{206}Pb^*$ with respect to radiogenic, blank and initial common Pb.
(d) Measured ratio corrected for spike and fractionation only. Mass discrimination of 0.25%/amu based on analysis of NBS-982; all Daly analyses.
(e) Corrected for fractionation, spike, and common Pb; all common Pb was assumed to be procedural blank: 206Pb/204Pb = 18.50±1.0%; 207Pb/204Pb = 15.50±1.0%; 208Pb/204Pb = 38.40±1.0% (1s errors).
(f) Errors are 2-sigma, propagated using the algorithms of Schmitz and Schoene (2007) and Crowley et al. (2007).
(g) Calculations are based on the decay constants of Jaffey et al. (1971). 206Pb/238U and 207Pb/206Pb ages corrected for initial disequilibrium in 230Th/238U using Th/U [magma] = 3.
(h) Nominal fraction weights estimated from photomicrographic grain dimensions, adjusted for partial dissolution during chemical abrasion.
(i) Nominal U and total Pb concentrations subject to uncertainty in photomicrographic estimation of weight and partial dissolution during chemical abrasion.

APPENDIX 2: MATERIAL EXAMINED

Table showing catalog information for collected and described Pliensbachian–Toarcian ammonoids from the Luning Embayment. Specimens are curated at the University of Montana Paleontology Center (UMPC) in Missoula, Montana. Cat. No. = Catalog Number; Section = Stratigraphic Section in this study; Loc. No. = Locality Number within the measured section.

UMPC Cat. No.	Section	Loc. No.	Taxon	Elements	Notes	Age
15041	Westgate North	21	*Phylloceras hebertinum*	1	Pl. 1, Fig. 1 (float)	upper Pliensbachian (Carlottense Zone)
15042	Westgate North	13	*Juraphyllites*? sp.	1	Pl. 1, Figs. 2-4 (float)	upper Pliensbachian (Carlottense Zone)
15043	Westgate Ridge	12	*Fanninoceras* (*F.*) *carlottense*	1	Pl. 1, Figs. 5-7	upper Pliensbachian (Carlottense Zone)
15044	Westgate Ridge	15	*Fanninoceras* (*F.*) *carlottense*	2	Pl. 1, Fig 8 (latex figured)	upper Pliensbachian (Carlottense Zone)
15045	Westgate Ridge	15	*Fanninoceras* (*F.*) *carlottense*	1	Pl. 1, Fig. 9	upper Pliensbachian (Carlottense Zone)
15046	Westgate Ridge	14	*Fanninoceras* (*F.*) *carlottense*	1	Pl. 1, Fig. 10, 11	upper Pliensbachian (Carlottense Zone)
15047	Westgate Ridge	15	*Fanninoceras* (*F.*) *carlottense*	1	not figured	upper Pliensbachian (Carlottense Zone)
15048	Westgate Ridge	14	*Fanninoceras* (*F.*) *carlottense*	6	not figured	upper Pliensbachian (Carlottense Zone)
15049	Westgate North	13	*Fanninoceras* (*F.*) *carlottense*	1	not figured	upper Pliensbachian (Carlottense Zone)
15050	Westgate North	11	*Fanninoceras* (*F.*) *carlottense*	1	not figured (float)	upper Pliensbachian (Carlottense Zone)
15051	Westgate North	13	*Fanninoceras* (*F.*) *carlottense*	1	not figured (float)	upper Pliensbachian (Carlottense Zone)
15052	New York Canyon Type area (ii)	1	*Fanninoceras* (*F.*) *carlottense*	1	not figured	upper Pliensbachian (Carlottense Zone)
15053	New York Canyon Entrance	5	*Fanninoceras* (*F.*) *carlottense*	1	not figured (float)	upper Pliensbachian (Carlottense Zone)
15054	New York Canyon Type area (vi)	4	*Fanninoceras* (*F.*) *fannini*	2	Pl. 2, Figs. 1, 2 (float)	upper Pliensbachian (Kunae Zone)
15055	Westgate North	12	*Fanninoceras* (*F.*) *fannini*	1	Pl. 2, Fig. 3	upper Pliensbachian (Kunae Zone)
15056	Westgate North	12	*Fanninoceras* (*F.*) *fannini*	3	Pl. 2, Fig. 4	upper Pliensbachian (Kunae Zone)
15057	Westgate North	13	*Fanninoceras* (*F.*) *fannini*	1	Pl. 2, Fig. 5	upper Pliensbachian (Carlottense Zone)
15058	Westgate North	13	*Fanninoceras* (*F.*) *fannini*	1	Pl. 2, Fig. 6	upper Pliensbachian (Carlottense Zone)
15059	Westgate North	2	*Fanninoceras* (*F.*) *fannini*	1	not figured (float)	upper Pliensbachian (Kunae Zone?)
15060	Westgate North	13	*Fanninoceras* (*F.*) *fannini*	1	not figured	upper Pliensbachian (Carlottense Zone)
15061	Westgate North	4	*Fanninoceras* (*F.*) *fannini*	1	not figured	upper Pliensbachian (Kunae Zone)
15062	New York Canyon Type area (iv)	3	*Fanninoceras* (*F.*) cf. *kunae*	1	Pl. 2, Fig. 7 (latex figured)	upper Pliensbachian (Kunae Zone)
15063	New York Canyon Type area (v)	9	*Fanninoceras* (*C.*) *maudense*	1	Pl. 2, Fig. 8 (float)	upper Pliensbachian
15064	New York Canyon Type area (ii)	2	*Fanninoceras* sp.	1	not figured	upper Pliensbachian
15065	New York Canyon Type area (i)	7	*Fanninoceras* sp.	1	not figured	upper Pliensbachian
15066	New York Canyon Type area (vi)	2	*Acanthopleuroceras whiteavesi*	1	Pl. 2, Figs. 9, 10	lower Pliensbachian (Whiteavesi Zone)
15067	New York Canyon Type area (v)	3	*Acanthopleuroceras whiteavesi*	5	Pl. 2, Fig. 11	lower Pliensbachian (Whiteavesi Zone)
15068	New York Canyon Type area (v)	1	*Acanthopleuroceras* sp.	1	Pl. 2, Fig. 12	lower Pliensbachian (Whiteavesi Zone)

Appendix 2, continued.

UMPC Cat. No.	Section	Loc. No.	Taxon	Elements	Notes	Age
15069	New York Canyon Type area (i)	1	*Tropidoceras flandrini* cf. *obtusa*	1	Pl. 2, Fig. 13 (float)	lower Pliensbachian (Whiteavesi Zone)?
15070	New York Canyon Type area (iv)	1	*Tropidoceras flandrini* cf. *obtusa*	1	Pl. 2, Fig. 14 (float)	lower Pliensbachian (Whiteavesi Zone)?
15071	New York Canyon Type area (i)	1	*Tropidoceras flandrini* cf. *obtusa*	1	Pl. 3, Fig. 1 (float)	lower Pliensbachian (Whiteavesi Zone)?
15072	New York Canyon Type area (v)	2	*Tropidoceras flandrini* cf. *obtusa*	1	Pl. 3, Fig. 2, 3 (float)	lower Pliensbachian (Whiteavesi Zone)?
15073	Westgate Ridge	3	*Dubariceras freboldi*	1	Pl. 4, Fig. 1 (float)	lower Pliensbachian (Freboldi Zone)?
15074	New York Canyon Type area (i)	4	*Dubariceras freboldi*	2	Pl. 4, Fig. 2	lower Pliensbachian (Freboldi Zone)
15075	New York Canyon Type area (i)	4	*Dubariceras freboldi*	1	Pl. 4, Fig. 3	lower Pliensbachian (Freboldi Zone)
15076	New York Canyon Entrance	2	*Dubariceras freboldi*	1	Pl. 4, Fig. 4	lower Pliensbachian (Freboldi Zone)
15077	New York Canyon Type area (i)	4	*Dubariceras freboldi*	1	Pl. 4, Fig. 5	lower Pliensbachian (Freboldi Zone)
15078	New York Canyon Type area (i)	4	*Dubariceras freboldi*	4	not figured	lower Pliensbachian (Freboldi Zone)
15079	New York Canyon Type area (i)	4	*Dubariceras freboldi*	1	not figured	lower Pliensbachian (Freboldi Zone)
15080	New York Canyon Type area (i)	3	*Dubariceras freboldi*	6	not figured	lower Pliensbachian (Freboldi Zone)
15081	New York Canyon Type area (v)	6	*Dubariceras* cf. *freboldi*	11	not figured	lower Pliensbachian (Freboldi Zone)
15082	New York Canyon Entrance	2	*Dubariceras freboldi*	1	not figured	lower Pliensbachian (Freboldi Zone)
15083	New York Canyon Entrance	3	*Dubariceras freboldi*	1	not figured	lower Pliensbachian (Freboldi Zone)
15084	New York Canyon Entrance	4	*Dubariceras freboldi*	1	not figured	lower Pliensbachian (Freboldi Zone)
15085	New York Canyon Entrance	2	*Dubariceras freboldi*	1	not figured (float)	lower Pliensbachian (Freboldi Zone)
15086	Westgate Ridge	3	*Dubariceras freboldi*	1	not figured (float)	lower Pliensbachian (Freboldi Zone)
15087	Westgate Ridge	3	*Dubariceras freboldi*	5	not figured	lower Pliensbachian (Freboldi Zone)
15088	New York Canyon Type area (vi)	1	*Metaderoceras evolutum*	1	Pl. 4, Figs. 6, 7 (float)	lower Pliensbachian (Whiteavesi Zone)?
15089	New York Canyon Type area (i)	2	*Metaderoceras evolutum*	1	Pl. 4, Figs. 8, 9	lower Pliensbachian (Whiteavesi Zone)
15090	New York Canyon Type area (i)	2	*Metaderoceras evolutum*	1	Pl. 4, Fig. 10	lower Pliensbachian (Whiteavesi Zone)
15091	New York Canyon Type area (i)	2	*Metaderoceras evolutum*	1	Pl. 4, Fig. 13	lower Pliensbachian (Whiteavesi Zone)
15092	New York Canyon Type area (v)	1	*Metaderoceras evolutum*	1	not figured (float)	lower Pliensbachian (Whiteavesi Zone)?

Appendix 2, continued.

UMPC Cat. No.	Section	Loc. No.	Taxon	Elements	Notes	Age
15093	New York Canyon Type area (i)	2	*Metaderoceras evolutum*	2	not figured	lower Pliensbachian (Whiteavesi Zone)
15094	Westgate Ridge	2	*Metaderoceras* cf. *mouterdi*	1	Pl. 4, Figs. 11, 12 (float)	lower Pliensbachian (Whiteavesi Zone)
15095	New York Canyon	float	*Metaderoceras* cf. *mouterdi*	1	not figured (float)	lower Pliensbachian (Whiteavesi Zone)?
15096	New York Canyon Type area (vi)	2	*Metaderoceras* cf. *mouterdi*	1	not figured (float)	lower Pliensbachian (Whiteavesi Zone)?
15097	New York Canyon Type area (vi)	1	*Metaderoceras talkeetnaense*	1	Pl. 4, Fig. 14 (float)	lower Pliensbachian (Whiteavesi Zone)?
15098	New York Canyon Type area (vi)	2	*Metaderoceras talkeetnaense*	1	Pl. 4, Figs. 15, 16	lower Pliensbachian (Whiteavesi Zone)
15099	New York Canyon Type area (i)	1	*Metaderoceras talkeetnaense*	3	Pl. 5, Fig. 1 (latex figured)	lower Pliensbachian (Whiteavesi Zone)
15100	New York Canyon Type area (vi)	1	*Metaderoceras talkeetnaense*	6	not figured (float)	lower Pliensbachian (Whiteavesi Zone)?
15101	New York Canyon Type area (vi)	2	*Metaderoceras talkeetnaense*	9	not figured	lower Pliensbachian (Whiteavesi Zone)
15102	New York Canyon Type area (v)	4	*Metaderoceras talkeetnaense*	1	not figured	lower Pliensbachian (Whiteavesi Zone)
15103	New York Canyon Type area (i)	5	*Metaderoceras talkeetnaense* & *Dubariceras freboldi*	2	not figured	lower Pliensbachian (Freboldi Zone)
15104	New York Canyon Entrance	1	*Metaderoceras talkeetnaense*	1	not figured	lower Pliensbachian (Whiteavesi Zone)
15105	New York Canyon Type area (i)	4	*Metaderoceras talkeetnaense*	1	not figured	lower Pliensbachian (Whiteavesi Zone)
15106	New York Canyon Type area (i)	3	*Metaderoceras talkeetnaense*	1	not figured	lower Pliensbachian (Whiteavesi Zone)
15107	New York Canyon Type area (i)	4	*Metaderoceras talkeetnaense*	9	not figured	lower Pliensbachian (Whiteavesi Zone)
15108	New York Canyon Type area (v)	8	*Reynesocoeloceras mortilleti*	1	Pl. 5, Fig. 2 (latex figured)	upper Pliensbachian (Kunae Zone)
15109	New York Canyon Type area (v)	10	*Reynesocoeloceras mortilleti*	1	not figured	upper Pliensbachian (Kunae Zone)
15110	Westgate North	7	*Reynesocoeloceras corvalani* n. sp.	1	Pl. 5, Figs. 3-5 (float) (Paratype)	upper Pliensbachian (Kunae Zone?)
15111	New York Canyon Type area (vi)	3	*Reynesocoeloceras corvalani* n. sp.	1	Pl. 5, Figs. 6, 7 (float) (Paratype)	upper Pliensbachian (Kunae Zone?)
15112	Westgate Ridge	13	*Reynesocoeloceras corvalani* n. sp.	1	Pl. 5, Figs. 8, 9 (Holotype)	upper Pliensbachian (Kunae Zone)
15113	Westgate Ridge	6	*Reynesocoeloceras corvalani* n. sp.	2	not figured	upper Pliensbachian (Kunae Zone)
15114	Westgate Ridge	4	*Reynesocoeloceras corvalani* n. sp.	1	not figured	Pliensbachian (Freboldi Zone)
15115	Westgate Ridge	5	*Prodactylioceras* cf. *davoei*	2	Pl. 6, Figs. 1, 2	upper Pliensbachian (Kunae Zone)

Appendix 2, continued.

UMPC Cat. No.	Section	Loc. No.	Taxon	Elements	Notes	Age
15116	Westgate North	8	*Prodactylioceras* cf. *davoei*	1	not figured	upper Pliensbachian (Kunae Zone)
15117	Westgate Ridge	9	*Prodactylioceras westgatenses* n. sp.	1	Pl. 6, Figs. 3, 4 (Holotype)	Pliensbachian (Freboldi–Kunae zones)
15118	Westgate North	4	*Prodactylioceras westgatenses* n. sp.	1	not figured	Pliensbachian (Freboldi–Kunae zones)
15119	Westgate Ridge	21	*Cetonoceras*? sp.	1	Pl. 6, Fig. 5 (latex figured)	upper Pliensbachian (Carlottense Zone)
15120	Westgate Ridge	6	*Reynesoceras colubriforme*	1	Pl. 7, Figs. 1, 2 (float)	upper Pliensbachian (Kunae Zone)
15121	Westgate North	2	*Reynesoceras italicum*	1	Pl. 7, Fig. 3 (float)	upper Pliensbachian (Kunae Zone)
15122	Westgate Ridge	7	*Reynesoceras italicum*	1	Pl. 7, Fig. 4	upper Pliensbachian (Kunae Zone)
15123	Westgate Ridge	7	*Reynesoceras italicum*	1	Pl. 7, Fig. 5	upper Pliensbachian (Kunae Zone)
15124	Westgate Ridge	8	*Reynesoceras italicum*	1	not figured	upper Pliensbachian (Kunae Zone)
15125	Westgate Ridge	7	*Reynesoceras italicum*	1	not figured	upper Pliensbachian (Kunae Zone)
15126	Westgate Ridge	10	*Reynesoceras italicum*	1	not figured	upper Pliensbachian (Kunae Zone)
15127	Westgate Ridge	9	*Reynesoceras italicum*	1	not figured (float)	upper Pliensbachian (Kunae Zone)
15128	Westgate Ridge	7	*Reynesoceras italicum*	1	not figured (float)	upper Pliensbachian (Kunae Zone)
15129	Westgate North	7	*Reynesoceras italicum*	1	not figured (float)	upper Pliensbachian (Kunae Zone)
15130	Westgate North	7	*Reynesoceras italicum*	1	not figured (float)	upper Pliensbachian (Kunae Zone)
15131	Westgate North	9	*Reynesoceras italicum*	1	not figured	upper Pliensbachian (Kunae Zone)
15132	Westgate North	7	*Reynesoceras italicum*	1	not figured (float)	upper Pliensbachian (Kunae Zone)
15133	Westgate North	7	*Reynesoceras italicum*	1	not figured (float)	upper Pliensbachian (Kunae Zone)
15134	Westgate North	1	*Reynesoceras italicum*	1	not figured (float)	upper Pliensbachian (Kunae Zone)
15135	New York Canyon Entrance	9	*Dactylioceras* (*O.*) *chilense*	1	Pl. 7, Fig. 6	lower Toarcian (Kanense Zone)
15136	New York Canyon Entrance	7	*Dactylioceras* (*O.*) *chilense*	1	Pl. 7, Figs. 7, 8	lower Toarcian (Kanense Zone)
15137	Westgate Ridge	47	*Dactylioceras* (*O.*) *chilense*	1	not figured (float)	lower Toarcian (Kanense Zone)
15138	Westgate Ridge	41	*Dactylioceras* (*O.*) *chilense*	1	not figured	lower Toarcian (Kanense Zone)
15139	Westgate Ridge	41	*Dactylioceras* (*O.*) *chilense*	2	not figured	lower Toarcian (Kanense Zone)
15140	Westgate North	32	*Dactylioceras* (*O.*) *chilense*	1	not figured	lower Toarcian (Kanense Zone)
15141	Westgate Ridge	52	*Dactylioceras* (*O.*) cf. *helianthoides*	1	Pl. 8, Figs. 1, 2	lower Toarcian (Kanense Zone)
15142	Westgate Ridge	52	*Dactylioceras* (*O.*) cf. *hoelderi*	1	Pl. 8, Figs. 3, 4	lower Toarcian (Kanense Zone)
15143	Westgate Ridge	41	*Dactylioceras* (*O.*) *kanense*	1	Pl. 8, Fig. 5	lower Toarcian (Kanense Zone)
15144	Westgate South	5	*Dactylioceras* (*O.*) *kanense*	1	Pl. 8, Figs. 6, 7	lower Toarcian (Kanense Zone)
15145	Westgate Ridge	52	*Nodicoeloceras nevadaense* n. sp.	1	Pl. 8, Fig. 8 (latex figured) (Paratype)	lower Toarcian (Kanense Zone)
15146	Westgate Ridge	48	*Nodicoeloceras nevadaense* n. sp.	1	Pl. 8, Figs. 9, 10 (Paratype)	lower Toarcian (Kanense Zone)
15147	Westgate North	35	*Nodicoeloceras nevadaense* n. sp.	1	Pl. 8, Fig. 11	lower Toarcian (Kanense Zone)
15148	Westgate Ridge	27	*Nodicoeloceras nevadaense* n. sp.	1	Pl. 8, Fig. 12 (float)	lower Toarcian (Kanense Zone)
15149	Westgate Ridge	43	*Nodicoeloceras nevadaense* n. sp.	1	Pl. 8, Fig. 13	lower Toarcian (Kanense Zone)
15150	Westgate Ridge	35	*Nodicoeloceras nevadaense* n. sp.	2	Pl. 8, Fig. 14	lower Toarcian (Kanense Zone)

Appendix 2, continued.

UMPC Cat. No.	Section	Loc. No.	Taxon	Elements	Notes	Age
15151	New York Canyon Entrance	8	*Nodicoeloceras nevadaense* n. sp.	1	Pl. 8, Figs. 15, 16 (float) (Holotype)	lower Toarcian (Kanense Zone)
15152	Westgate Ridge	43	*Nodicoeloceras nevadaense* n. sp.	1	Pl. 8, Fig. 17 (float)	lower Toarcian (Kanense Zone)
15153	Westgate Ridge	35	*Nodicoeloceras nevadaense* n. sp.	1	Pl. 9, Figs. 1, 2 (float)	lower Toarcian (Kanense Zone)
15154	Westgate Ridge	27	*Nodicoeloceras nevadaense* n. sp.	2	Pl. 9, Figs. 3, 4 (float)	lower Toarcian (Kanense Zone)
15155	Westgate Ridge	51	*Nodicoeloceras nevadaense* n. sp.	2	not figured (float)	lower Toarcian (Kanense Zone)
15156	Westgate Ridge	43	*Nodicoeloceras nevadaense* n. sp.	1	not figured	lower Toarcian (Kanense Zone)
15157	Westgate Ridge	na	*Nodicoeloceras nevadaense* n. sp.	1	not figured (float)	lower Toarcian (Kanense Zone)
15158	Westgate Ridge	27	*Nodicoeloceras nevadaense* n. sp.	1	not figured (float)	lower Toarcian (Kanense Zone)
15159	Westgate Ridge	41	*Nodicoeloceras nevadaense* n. sp.	1	not figured	lower Toarcian (Kanense Zone)
15160	Westgate Ridge	53	*Nodicoeloceras nevadaense* n. sp.	1	not figured	lower Toarcian (Kanense Zone)
15161	Westgate Ridge	52	*Nodicoeloceras nevadaense* n. sp.	1	not figured (float)	lower Toarcian (Kanense Zone)
15162	Westgate Ridge	52	*Nodicoeloceras nevadaense* n. sp.	1	not figured	lower Toarcian (Kanense Zone)
15163	Westgate Ridge	52	*Nodicoeloceras nevadaense* n. sp.	1	not figured (float)	lower Toarcian (Kanense Zone)
15164	Westgate Ridge	52	*Nodicoeloceras nevadaense* n. sp.	6	not figured	lower Toarcian (Kanense Zone)
15165	Westgate Ridge	43	*Nodicoeloceras nevadaense* n. sp.	2	not figured	lower Toarcian (Kanense Zone)
15166	Westgate Ridge	43	*Nodicoeloceras nevadaense* n. sp.	1	not figured	lower Toarcian (Kanense Zone)
15167	Westgate North	33	*Nodicoeloceras nevadaense* n. sp.	1	not figured (float)	lower Toarcian (Kanense Zone)
15168	Westgate North	33	*Nodicoeloceras nevadaense* n. sp.	3	not figured	lower Toarcian (Kanense Zone)
15169	Westgate North	34	*Nodicoeloceras nevadaense* n. sp.	1	not figured	lower Toarcian (Kanense Zone)
15170	Westgate North	21	*Nodicoeloceras nevadaense* n. sp.	1	not figured (float)	lower Toarcian (Kanense Zone)
15171	Westgate North	22	*Nodicoeloceras nevadaense* n. sp.	2	not figured (float)	lower Toarcian (Kanense Zone)
15172	Westgate North	7	*Nodicoeloceras nevadaense* n. sp.	2	not figured (float)	lower Toarcian (Kanense Zone)
15173	Westgate South	5	*Nodicoeloceras nevadaense* n. sp.	1	not figured	lower Toarcian (Kanense Zone)
15174	Westgate South	6	*Nodicoeloceras nevadaense* n. sp.	1	not figured	lower Toarcian (Kanense Zone)
15175	Westgate Ridge	52	*Nodicoeloceras middlegatense* n. sp.	1	Pl. 9, Figs. 5, 6 (Holotype)	lower Toarcian (Kanense Zone)
15176	Westgate North	38	*Collina*? sp.	1	Pl. 10, Fig. 1 (float, latex figured)	middle Toarcian
15177	Westgate North	7	*Liparoceras* (*Becheiceras*) sp.	1	Pl. 10, Fig. 2 (float)	upper Pliensbachian (Kunae Zone)
15178	Westgate Ridge	11	*Arieticeras* cf. *algovianum*	1	Pl. 10, Figs. 3, 4 (3 is latex)	upper Pliensbachian (Kunae Zone)
15179	Westgate Ridge	13	*Arieticeras* cf. *algovianum*	3	Pl. 10, Figs. 5, 6	upper Pliensbachian (Carlottense Zone)
15180	Westgate North	10	*Arieticeras* cf. *algovianum*	1	not figured (float)	upper Pliensbachian (Kunae Zone)
15181	Westgate North	13	*Arieticeras* cf. *algovianum*	1	not figured	upper Pliensbachian (Carlottense Zone)
15182	New York Canyon Type area (vi)	5	*Arieticeras* sp.	1	not figured (float)	Pliensbachian
15183	Westgate North	9	*Arieticeras*? sp.	1	not figured (float)	upper Pliensbachian (Kunae Zone)
15184	Westgate North	3	*Leptaleoceras* cf. *accuratum*	1	Pl. 10, Fig. 7	upper Pliensbachian (Kunae Zone)

Appendix 2, continued.

UMPC Cat. No.	Section	Loc. No.	Taxon	Elements	Notes	Age
15185	Westgate North	3	*Leptaleoceras* cf. *accuratum*	1	Pl. 10, Fig. 8	upper Pliensbachian (Kunae Zone)
15186	Westgate North	4	*Leptaleoceras* cf. *accuratum*	1	not figured	upper Pliensbachian (Kunae Zone)
15187	New York Canyon Type area (v)	7	*Leptaleoceras*? sp.	1	not figured	upper Pliensbachian (Kunae Zone)
15188	Westgate North	14	*Fontanelliceras* sp.	1	Pl. 10, Fig. 9	upper Pliensbachian (Carlottense Zone)
15189	Westgate Ridge	38	*Protogrammoceras* (*P.*) *kurrianum*	2	Pl. 10, Figs. 10, 11	upper Pliensbachian (Carlottense Zone)
15190	Westgate Ridge	11	*Protogrammoceras* (*P.*) *kurrianum*	2	Pl. 10, Figs. 12, 13	upper Pliensbachian (Kunae Zone)
15191	Westgate Ridge	39	*Protogrammoceras* (*P.*) *kurrianum*	2	Pl. 11, Fig. 1	lower Toarcian (Kanense Zone)
15192	Westgate North	7	*Protogrammoceras* (*P.*) *kurrianum*	1	Pl. 11, Fig. 2 (float)	upper Pliensbachian
15193	Westgate Ridge	44	*Protogrammoceras* (*P.*) *kurrianum*	1	Pl. 11, Fig. 3	lower Toarcian (Kanense Zone)
15194	Westgate Ridge	31	*Protogrammoceras* (*P.*) *kurrianum*	1	Pl. 11, Fig. 4 (latex figure)	upper Pliensbachian (Carlottense Zone)
15195	Westgate North	29	*Protogrammoceras* (*P.*) *kurrianum*	1	Pl. 11, Fig. 5	upper Pliensbachian (Carlottense Zone)
15196	Westgate Ridge	11	*Protogrammoceras* (*P.*) *kurrianum*	2	Pl. 11, Figs. 6, 7	upper Pliensbachian (Kunae Zone)
15197	Westgate North	28	*Protogrammoceras* (*P.*) *kurrianum*	1	not figured	upper Pliensbachian (Carlottense Zone)
15198	Westgate North	28	*Protogrammoceras* (*P.*) *kurrianum*	1	not figured	upper Pliensbachian (Carlottense Zone)
15199	Westgate North	24	*Protogrammoceras* (*P.*) *kurrianum*	1	not figured	upper Pliensbachian (Carlottense Zone)
15200	Westgate North	30	*Protogrammoceras* (*P.*) *kurrianum*	1	not figured	upper Pliensbachian (Carlottense Zone)
15201	Westgate North	16	*Protogrammoceras* (*P.*) *kurrianum*	1	not figured (float)	upper Pliensbachian (Carlottense Zone)
15202	Westgate North	31	*Protogrammoceras* (*P.*) *kurrianum*	1	not figured (float)	upper Pliensbachian (Carlottense Zone)
15203	Westgate North	35	*Protogrammoceras* (*P.*) *kurrianum*	1	not figured	lower Toarcian (Kanense Zone)
15204	Westgate Ridge	20	*Protogrammoceras* (*P.*) *kurrianum*	2	not figured	upper Pliensbachian (Carlottense Zone)
15205	Westgate North	28	*Protogrammoceras* (*P.*) *kurrianum*	1	not figured (float)	upper Pliensbachian (Carlottense Zone)
15206	Westgate Ridge	25	*Protogrammoceras* (*P.*) *kurrianum*	1	not figured (float)	upper Pliensbachian (Carlottense Zone)
15207	Westgate Ridge	33	*Protogrammoceras* (*P.*) *kurrianum*	2	not figured (float)	upper Pliensbachian (Carlottense Zone)
15208	Westgate Ridge	23	*Protogrammoceras* (*P.*) *kurrianum*	1	not figured (float)	upper Pliensbachian (Carlottense Zone)
15209	Westgate Ridge	17	*Protogrammoceras* (*P.*) *kurrianum*	1	not figured (float)	upper Pliensbachian (Carlottense Zone)
15210	Westgate Ridge	50	*Protogrammoceras* (*P.*) *kurrianum*	1	not figured	lower Toarcian (Kanense Zone)
15211	Westgate Ridge	26	*Protogrammoceras* (*P.*) *kurrianum*	1	not figured	upper Pliensbachian (Carlottense Zone)
15212	Westgate Ridge	28	*Protogrammoceras* (*P.*) *kurrianum*	1	not figured	upper Pliensbachian (Carlottense Zone)
15213	Westgate Ridge	21	*Protogrammoceras* (*P.*) *kurrianum*	1	not figured	upper Pliensbachian (Carlottense Zone)
15214	Westgate Ridge	19	*Protogrammoceras* (*P.*) *kurrianum*	1	not figured	upper Pliensbachian (Carlottense Zone)
15215	New York Canyon Type area (v)	2	*Protogrammoceras* (*P.*) *paltum*	1	Pl. 12, Figs. 1 2	upper Pliensbachian
15216	Westgate North	11	*Protogrammoceras* (*P.*) *paltum*	1	Pl. 12, Figs. 3, 4	upper Pliensbachian (Kunae Zone)
15217	Westgate Ridge	16	*Protogrammoceras* (*P.*) *paltum*	1	not figured (float)	upper Pliensbachian (Carlottense Zone)
15218	Westgate Ridge	16	*Protogrammoceras* (*P.*) *paltum*	1	not figured	upper Pliensbachian (Carlottense Zone)
15219	Westgate Ridge	46	*Protogrammoceras* (*P.*) *paltum*	1	not figured	upper Pliensbachian (Carlottense Zone)
15220	New York Canyon Type area (iv)	2	*Protogrammoceras* (*P.*) cf. *varicostatum*	1	Pl. 12, Figs. 5, 6	upper Pliensbachian (Kunae Zone)

Appendix 2, continued.

UMPC Cat. No.	Section	Loc. No.	Taxon	Elements	Notes	Age
15221	New York Canyon Type area (i)	6	*Protogrammoceras* (*P.*) sp.	1	not figured	upper Pliensbachian
15222	Westgate North	6	*Protogrammoceras* (*P.*) *tipperi* n. sp.	1	Pl. 12, Fig. 7 (Paratype)	upper Pliensbachian (Kunae Zone)
15223	Westgate Ridge	4	*Protogrammoceras* (*P.*) *tipperi* n. sp.	1	Pl. 13, Fig. 1 (Paratype)	Pliensbachian
15224	Westgate North	4	*Protogrammoceras* (*P.*) *tipperi* n. sp.	1	Pl. 14, Fig. 1 (Paratype)	Pliensbachian
15225	Westgate North	3	*Protogrammoceras* (*P.*) *tipperi* n. sp. *and Fanninoceras* (*F.*) *fannini*	2	not figured (float)	Pliensbachian (Kunae Zone)
15226	Westgate North	5	*Protogrammoceras* (*P.*) *tipperi* n. sp.	1	not figured	Pliensbachian
15227	Westgate North	5	*Protogrammoceras* (*P.*) *tipperi* n. sp.	1	not figured	Pliensbachian
15228	Westgate North	7	*Protogrammoceras* (*P.*) *tipperi* n. sp.	1	not figured	Pliensbachian
15229	Westgate North	6	*Protogrammoceras* (*P.*) *tipperi* n. sp.	1	not figured	Pliensbachian
15230	Westgate North	28	*Lioceratoides* cf. *allifordense*	1	Pl. 12, Fig. 13	upper Pliensbachian (Carlottense Zone)
15231	Westgate Ridge	24	*Lioceratoides* cf. *allifordense*	1	not figured	upper Pliensbachian (Carlottense Zone)
15232	Westgate Ridge	40	*Lioceratoides* cf. *involutum*	1	Pl. 12, Figs. 8, 9	upper Pliensbachian (Carlottense Zone)
15233	Westgate Ridge	15	*Lioceratoides* cf. *involutum*	1	Pl. 12, Figs. 10, 11	upper Pliensbachian (Carlottense Zone)
15234	Westgate Ridge	19	*Lioceratoides* cf. *involutum*	1	Pl. 12, Fig. 12	upper Pliensbachian (Carlottense Zone)
15235	Westgate Ridge	37	*Lioceratoides* cf. *involutum*	1	not figured	upper Pliensbachian (Carlottense Zone)
15236	Westgate Ridge	18	*Lioceratoides maurelli*	1	Pl. 15, Fig. 1	upper Pliensbachian (Carlottense Zone)
15237	Westgate Ridge	32	*Lioceratoides maurelli*	1	Pl. 15, Figs. 2, 3	upper Pliensbachian (Carlottense Zone)
15238	Westgate Ridge	32	*Lioceratoides maurelli*	2	not figured	upper Pliensbachian (Carlottense Zone)
15239	Westgate Ridge	21	*Lioceratoides maurelli*	1	not figured	upper Pliensbachian (Carlottense Zone)
15240	Westgate Ridge	22	*Lioceratoides maurelli*	2	not figured (float)	upper Pliensbachian (Carlottense Zone)
15241	Westgate Ridge	42	*Lioceratoides* (*P.*) *angionus*	1	Pl. 15, Fig. 9	lower Toarcian (Kanense Zone)
15242	Westgate North	18	*Lioceratoides* (*P.*) *propinquum*	1	Pl. 15, Fig. 4	upper Pliensbachian (Carlottense Zone)
15243	Westgate Ridge	47	*Lioceratoides* (*P.*) *propinquum*	1	Pl. 15, Fig. 5	lower Toarcian (Kanense Zone)
15244	Westgate Ridge	20	*Lioceratoides* (*P.*) *propinquum*	1	Pl. 15, Fig. 6	upper Pliensbachian (Carlottense Zone)
15245	Westgate North	17	*Lioceratoides* (*P.*) *propinquum*	1	Pl. 15, Fig. 7	upper Pliensbachian (Carlottense Zone)
15246	Westgate North	25	*Lioceratoides* (*P.*) *propinquum*	1	Pl. 15, Fig. 8	upper Pliensbachian (Carlottense Zone)
15247	Westgate Ridge	25	*Lioceratoides* (*P.*) *propinquum*	1	Pl. 15, Fig. 10	upper Pliensbachian (Carlottense Zone)
15248	Westgate Ridge	29	*Lioceratoides* (*P.*) *propinquum*	1	Pl. 15, Fig. 11	upper Pliensbachian (Carlottense Zone)
15249	Westgate Ridge	30	*Lioceratoides* (*P.*) *propinquum*	1	Pl. 15, Figs. 12, 13, 14	upper Pliensbachian (Carlottense Zone)
15250	Westgate Ridge	24	*Lioceratoides* (*P.*) *propinquum*	1	Pl. 15, Figs. 15, 16	upper Pliensbachian (Carlottense Zone)
15251	Westgate South	2	*Lioceratoides* (*P.*) *propinquum*	1	not figured	upper Pliensbachian (Carlottense Zone)
15252	New York Canyon Entrance	6	*Lioceratoides* (*P.*) *propinquum*	1	not figured	upper Pliensbachian (Carlottense Zone)
15253	Westgate North	10	*Lioceratoides* (*P.*) *propinquum*	1	not figured (float)	upper Pliensbachian (Kunae Zone)
15254	Westgate North	26	*Lioceratoides* (*P.*) *propinquum*	1	not figured	upper Pliensbachian (Carlottense Zone)
15255	Westgate North	23	*Lioceratoides* (*P.*) *propinquum*	1	not figured (float)	upper Pliensbachian (Carlottense Zone)

Appendix 2, continued.

UMPC Cat. No.	Section	Loc. No.	Taxon	Elements	Notes	Age
15256	Westgate North	19	*Lioceratoides* (*P.*) *propinquum*	1	not figured (float)	upper Pliensbachian (Carlottense Zone)
15257	Westgate North	25	*Lioceratoides* (*P.*) *propinquum*	1	not figured (float)	upper Pliensbachian (Carlottense Zone)
15258	Westgate North	13	*Lioceratoides* (*P.*) *propinquum*	1	not figured (float)	upper Pliensbachian (Carlottense Zone)
15259	Westgate North	20	*Lioceratoides* (*P.*) *propinquum*	1	not figured (float)	upper Pliensbachian (Carlottense Zone)
15260	Westgate North	29	*Lioceratoides* (*P.*) *propinquum*	1	not figured	upper Pliensbachian (Carlottense Zone)
15261	Westgate North	27	*Lioceratoides* (*P.*) *propinquum*	1	not figured	upper Pliensbachian (Carlottense Zone)
15262	Westgate North	28	*Lioceratoides* (*P.*) *propinquum*	10	not figured (in-place & float)	upper Pliensbachian (Carlottense Zone)
15263	Westgate North	23	*Lioceratoides* (*P.*) *propinquum*	1	not figured (float)	upper Pliensbachian (Carlottense Zone)
15264	Westgate North	16	*Lioceratoides* (*P.*) *propinquum*	1	not figured (float)	upper Pliensbachian (Carlottense Zone)
15265	Westgate North	18	*Lioceratoides* (*P.*) *propinquum*	1	not figured (float)	upper Pliensbachian (Carlottense Zone)
15266	Westgate North	18	*Lioceratoides* (*P.*) *propinquum*	1	not figured (float)	upper Pliensbachian (Carlottense Zone)
15267	Westgate Ridge	29	*Lioceratoides* (*P.*) *propinquum*	8	not figured	upper Pliensbachian (Carlottense Zone)
15268	Westgate Ridge	30	*Lioceratoides* (*P.*) *propinquum*	12	not figured	upper Pliensbachian (Carlottense Zone)
15269	Westgate Ridge	32	*Lioceratoides* (*P.*) *propinquum*	2	not figured	upper Pliensbachian (Carlottense Zone)
15270	Westgate Ridge	25	*Lioceratoides* (*P.*) *propinquum*	1	not figured	upper Pliensbachian (Carlottense Zone)
15271	Westgate Ridge	34	*Lioceratoides* (*P.*) *propinquum*	1	not figured (float)	upper Pliensbachian (Carlottense Zone)
15272	Westgate Ridge	19	*Lioceratoides* (*P.*) *propinquum*	1	not figured (float)	upper Pliensbachian (Carlottense Zone)
15273	Westgate Ridge	30	*Lioceratoides* (*P.*) *propinquum*	1	not figured (float)	upper Pliensbachian (Carlottense Zone)
15274	Westgate Ridge	34	*Lioceratoides* (*P.*) *propinquum*	1	not figured (float)	upper Pliensbachian (Carlottense Zone)
15275	Westgate Ridge	45	*Lioceratoides* (*P.*) *propinquum*	1	not figured	lower Toarcian (Kanense Zone)
15276	Westgate Ridge	42	*Lioceratoides* (*P.*) *propinquum*	2	not figured	lower Toarcian (Kanense Zone)
15277	Westgate Ridge	19	*Lioceratoides* (*P.*) *propinquum*	1	not figured (float)	upper Pliensbachian (Carlottense Zone)
15278	Westgate Ridge	43	*Lioceratoides* (*P.*) *propinquum*	1	not figured	lower Toarcian (Kanense Zone)
15279	Westgate Ridge	33	*Lioceratoides* (*P.*) *propinquum*	2	not figured	upper Pliensbachian (Carlottense Zone)
15280	Westgate Ridge	17	*Lioceratoides* (*P.*) *propinquum*	2	not figured (float)	upper Pliensbachian (Carlottense Zone)
15281	Westgate Ridge	43	*Lioceratoides* (*P.*) *propinquum*	2	not figured	lower Toarcian (Kanense Zone)
15282	Westgate Ridge	17	*Lioceratoides* (*P.*) *propinquum*	3	not figured	upper Pliensbachian (Carlottense Zone)
15283	Westgate Ridge	24	*Lioceratoides* (*P.*) *propinquum*	3	not figured	upper Pliensbachian (Carlottense Zone)
15284	Westgate Ridge	17	*Lioceratoides* (*P.*) *propinquum*	2	not figured	upper Pliensbachian (Carlottense Zone)
15285	Westgate Ridge	23	*Lioceratoides* (*P.*) *propinquum*	1	not figured (float)	upper Pliensbachian (Carlottense Zone)
15286	Westgate Ridge	20	*Lioceratoides* (*P.*) *propinquum*	5	not figured	upper Pliensbachian (Carlottense Zone)
15287	Westgate Ridge	49	*Tiltoniceras antiquum*	1	Pl. 16, Figs. 1, 2	lower Toarcian (Kanense Zone)
15288	Westgate Ridge	19	*Tiltoniceras antiquum*	1	Pl. 16, Figs. 3, 4	upper Pliensbachian (Carlottense Zone)
15289	Westgate Ridge	49	*Tiltoniceras antiquum*	1	Pl. 16, Fig. 5	lower Toarcian (Kanense Zone)
15290	Westgate Ridge	47	*Tiltoniceras antiquum*	1	not figured	lower Toarcian (Kanense Zone)
15291	Westgate Ridge	49	*Tiltoniceras antiquum*	5	not figured	lower Toarcian (Kanense Zone)
15292	Westgate Ridge	50	*Tiltoniceras antiquum*	1	not figured	lower Toarcian (Kanense Zone)
15293	Westgate Ridge	53	*Cleviceras exaratum*	1	Pl. 16, Figs. 6, 7	lower Toarcian (Kanense Zone)
15294	Westgate North	37	*Cleviceras exaratum*	1	Pl. 16, Fig. 8	lower Toarcian (Kanense Zone)
15295	Westgate North	37	*Cleviceras exaratum*	1	Pl. 16, Fig. 9	lower Toarcian (Kanense Zone)

Appendix 2, continued.

UMPC Cat. No.	Section	Loc. No.	Taxon	Elements	Notes	Age
15296	Westgate North	37	*Cleviceras exaratum*	1	Pl. 16, Figs. 10, 11	lower Toarcian (Kanense Zone)
15297	Westgate North	37	*Cleviceras exaratum*	1	not figured (float)	lower Toarcian (Kanense Zone)
15298	Westgate Ridge	53	*Cleviceras exaratum*	1	not figured (float)	lower Toarcian (Kanense Zone)
15299	Westgate Ridge	43	*Hildaites* cf. *murleyi*	1	Pl. 16, Fig. 12	lower Toarcian (Kanense Zone)
15300	Westgate South	7	*Hildaites* cf. *murleyi*	1	Pl. 16, Fig. 13	lower Toarcian (Kanense Zone)
15301	Westgate Ridge	7	*Reynesocoeloceras mortilleti*	2	not figured	Pliensbachian
15302	Westgate Ridge	49	*Dactylioceras* (*O.*) sp.	1	not figured	lower Toarcian (Kanense Zone)
15303	Westgate North	36	*Dactylioceras* (*O.*) sp.	1	not figured	lower Toarcian (Kanense Zone)
15304	Westgate Ridge	35	*Dactylioceras* (*O.*) sp.	3	not figured	lower Toarcian (Kanense Zone)
15305	Westgate North	38	*hildoceratid indet*	1	not figured	lower Toarcian (Kanense Zone)
15306	Westgate North	34	*Lioceratoides* (*P.*) *propinquum* & ichthyosaur vertebrae	1	not figured	lower Toarcian (Kanense Zone)
15307	New York Canyon Type area (iii)	1	*Fanninoceras* (*F.*) sp.	1	not figured	upper Pliensbachian (Kunae Zone)
15308	New York Canyon Type area (v)	1	*Metaderoceras* sp.	1	not figured	lower Pliensbachian (Whiteavesi Zone)
15309	Westgate Ridge	1	*Acanthopleuroceras whiteavesi*	1	not figured	lower Pliensbachian (Whiteavesi Zone)
15310	Westgate North	6	*Protogrammoceras* (*P.*) sp.	1	not figured	upper Pliensbachian (Kunae Zone)
15311	New York Canyon Type area (v)	5	*Acanthopleuroceras whiteavesi*	2	not figured	lower Pliensbachian (Whiteavesi Zone)

PLATES

PLATE 1

Scale bar at bottom left represents 1x magnification (1 cm), applicable for figs. 1–7, 9–11; Scale bar right of fig. 8 represents 1.5x magnification (1.5 cm).

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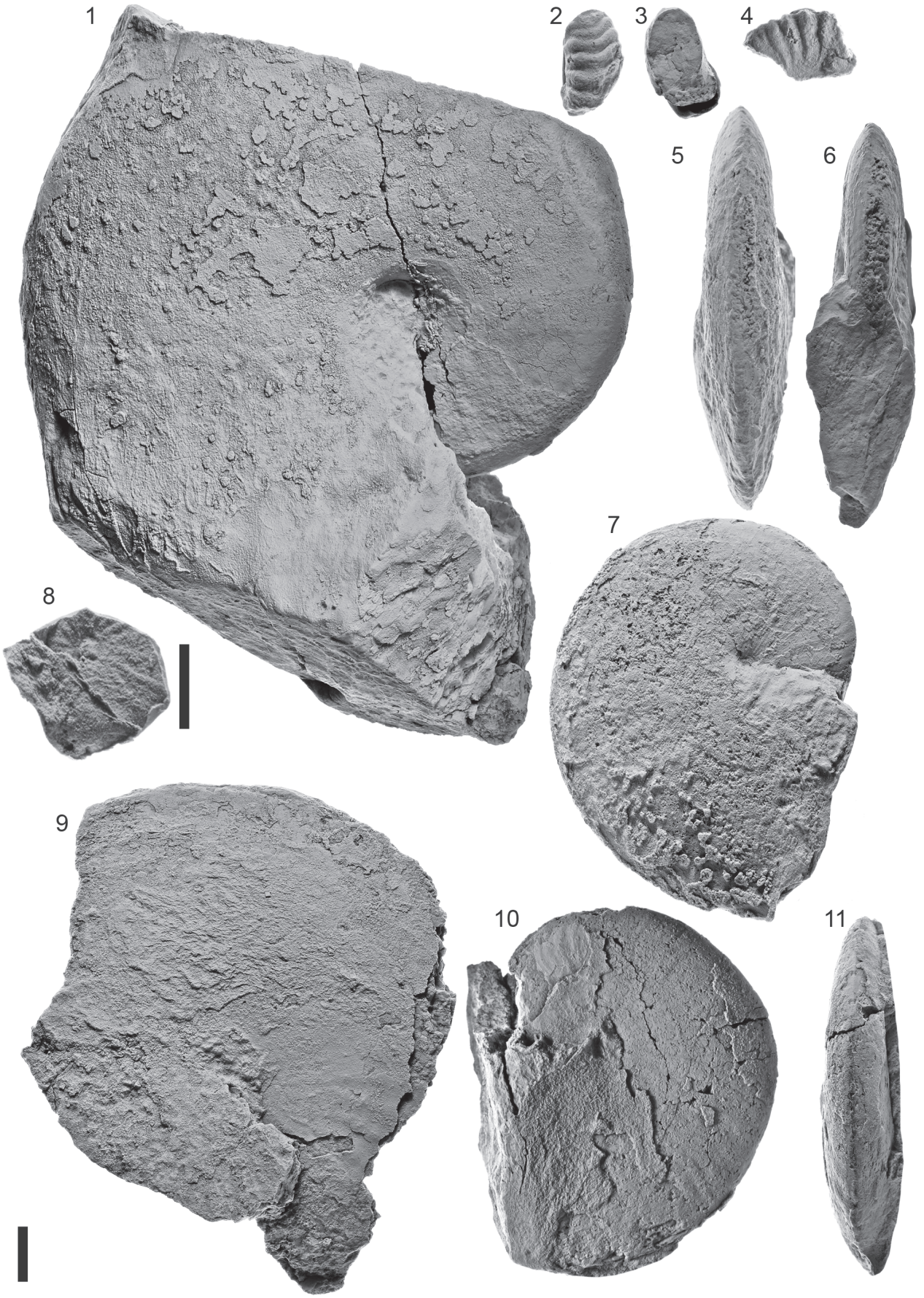
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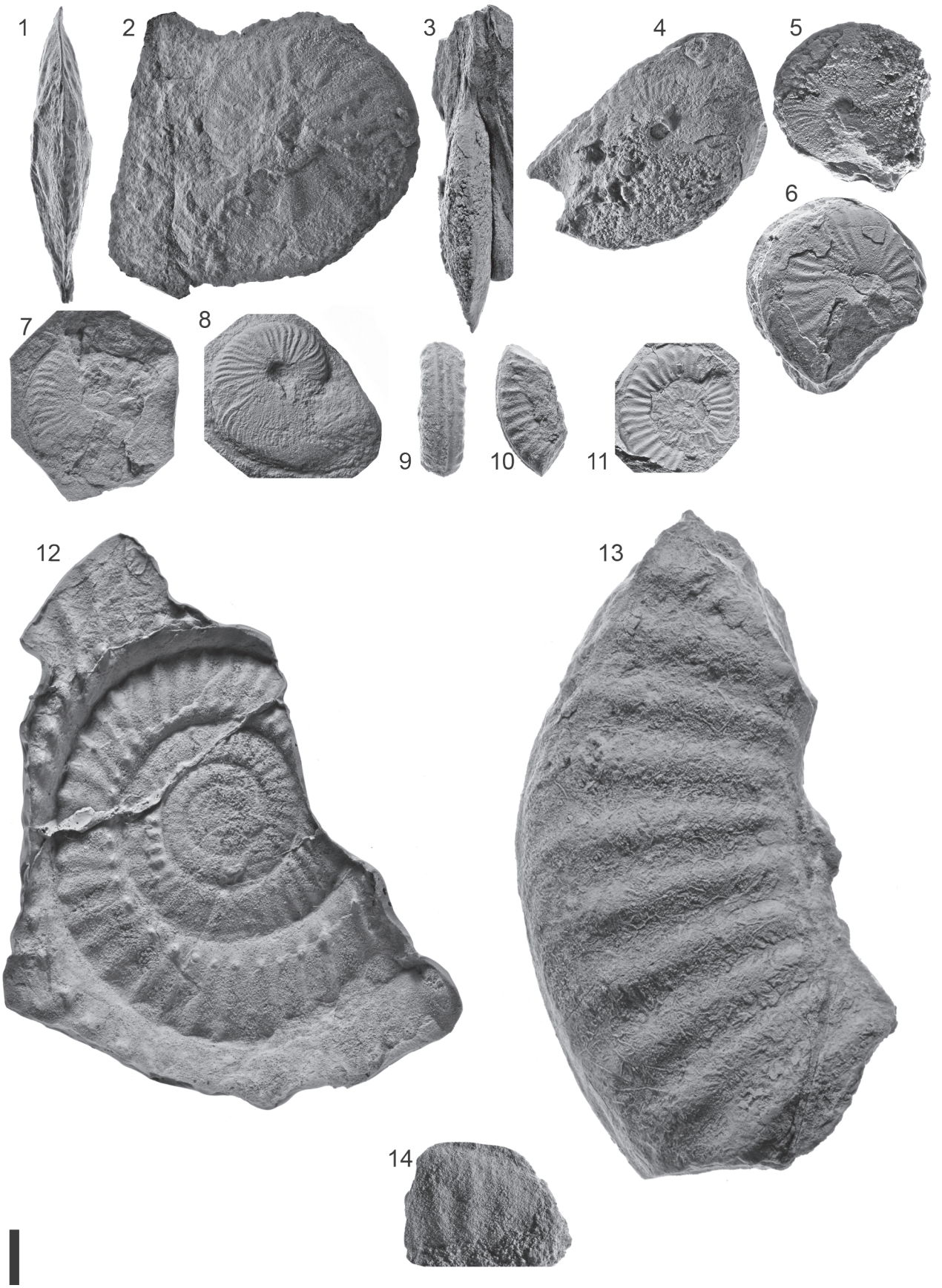
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Scale bar at bottom left represents 1x magnification (1 cm), applicable for figs. 1–14.

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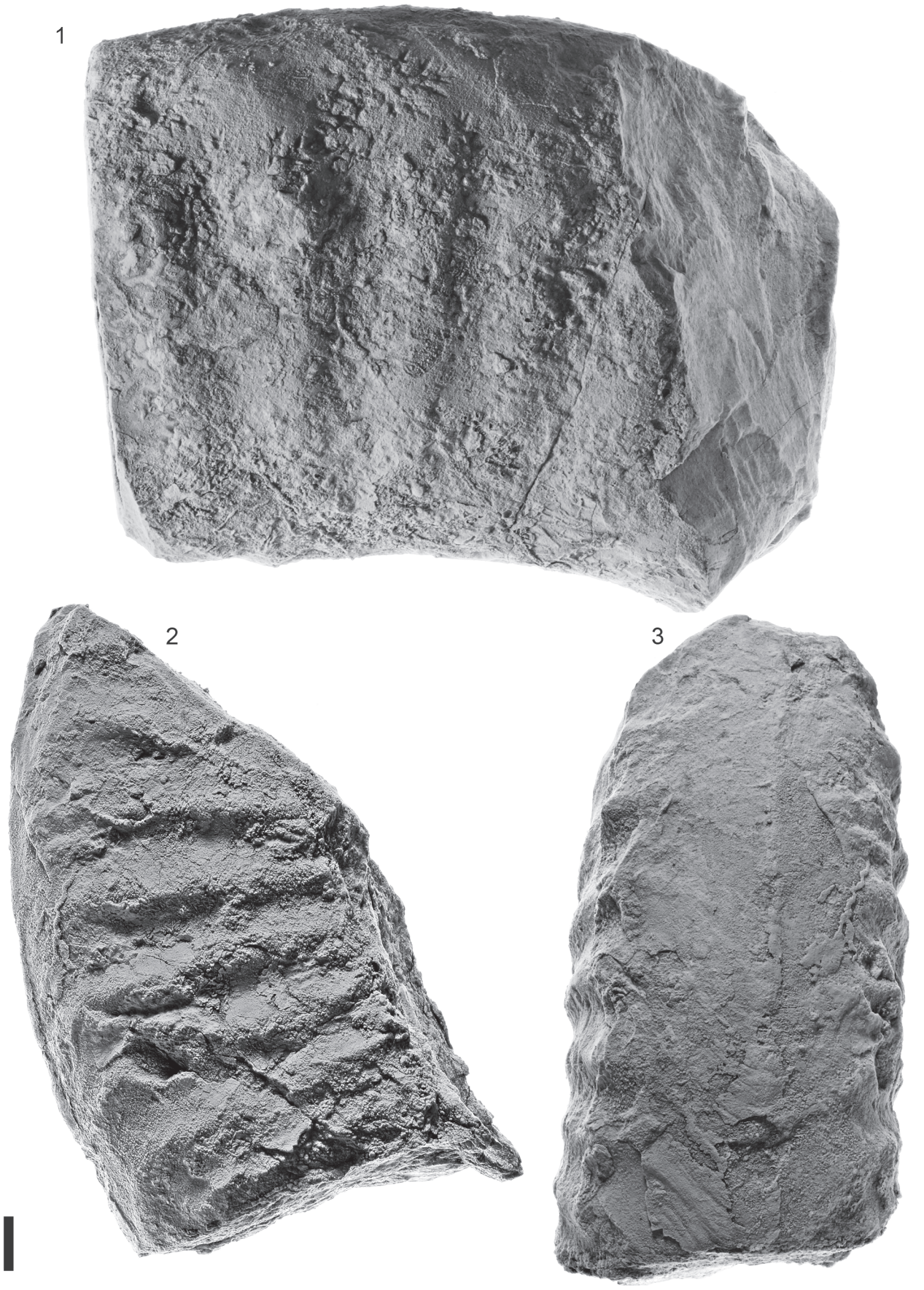
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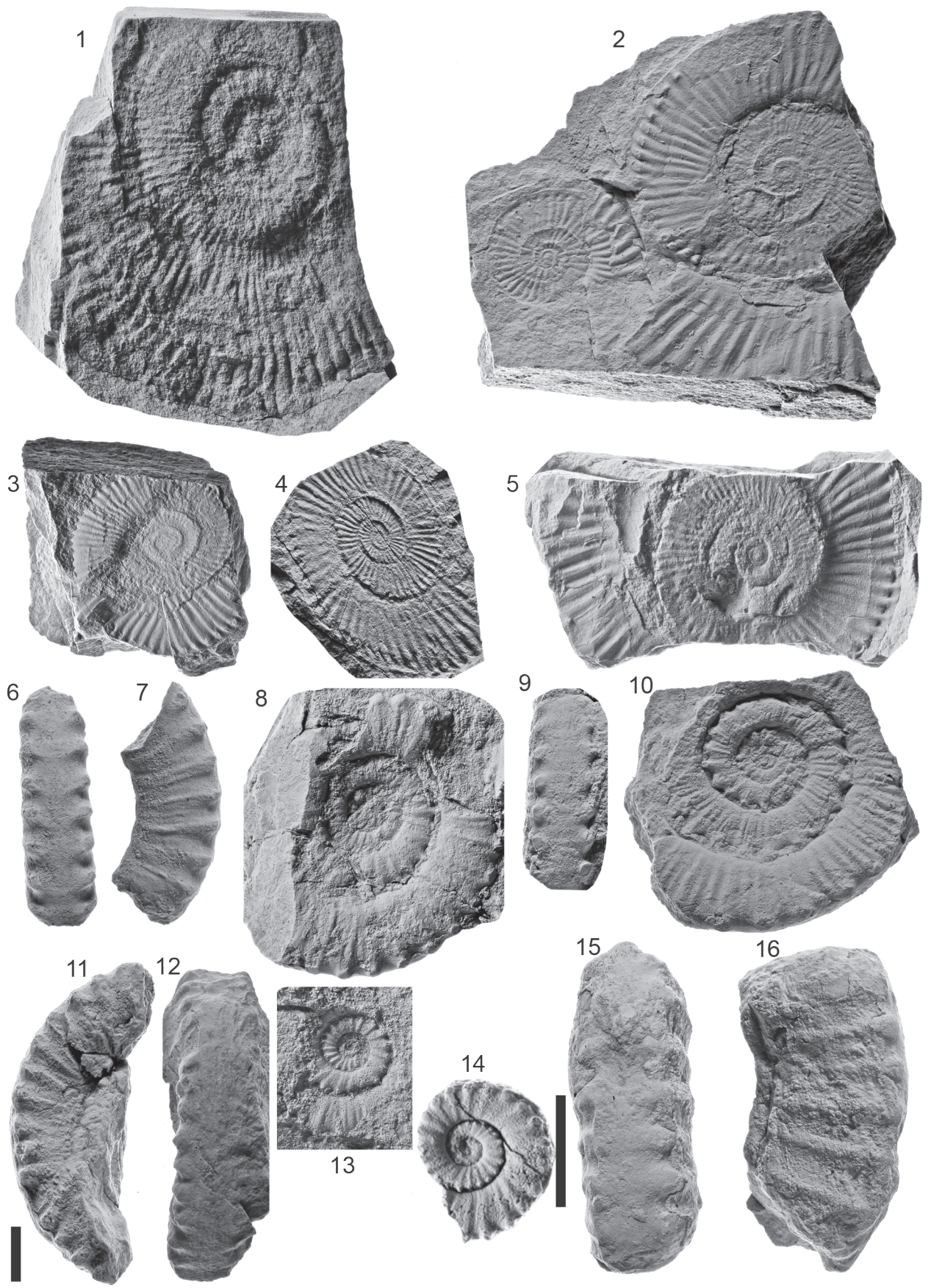
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Plate 4. Scale bar at bottom left represents 1x magnification (1 cm), applicable for figs. 1–13, 15, 16; Scale bar right of fig. 14 represents 2x magnification (2.0 cm).

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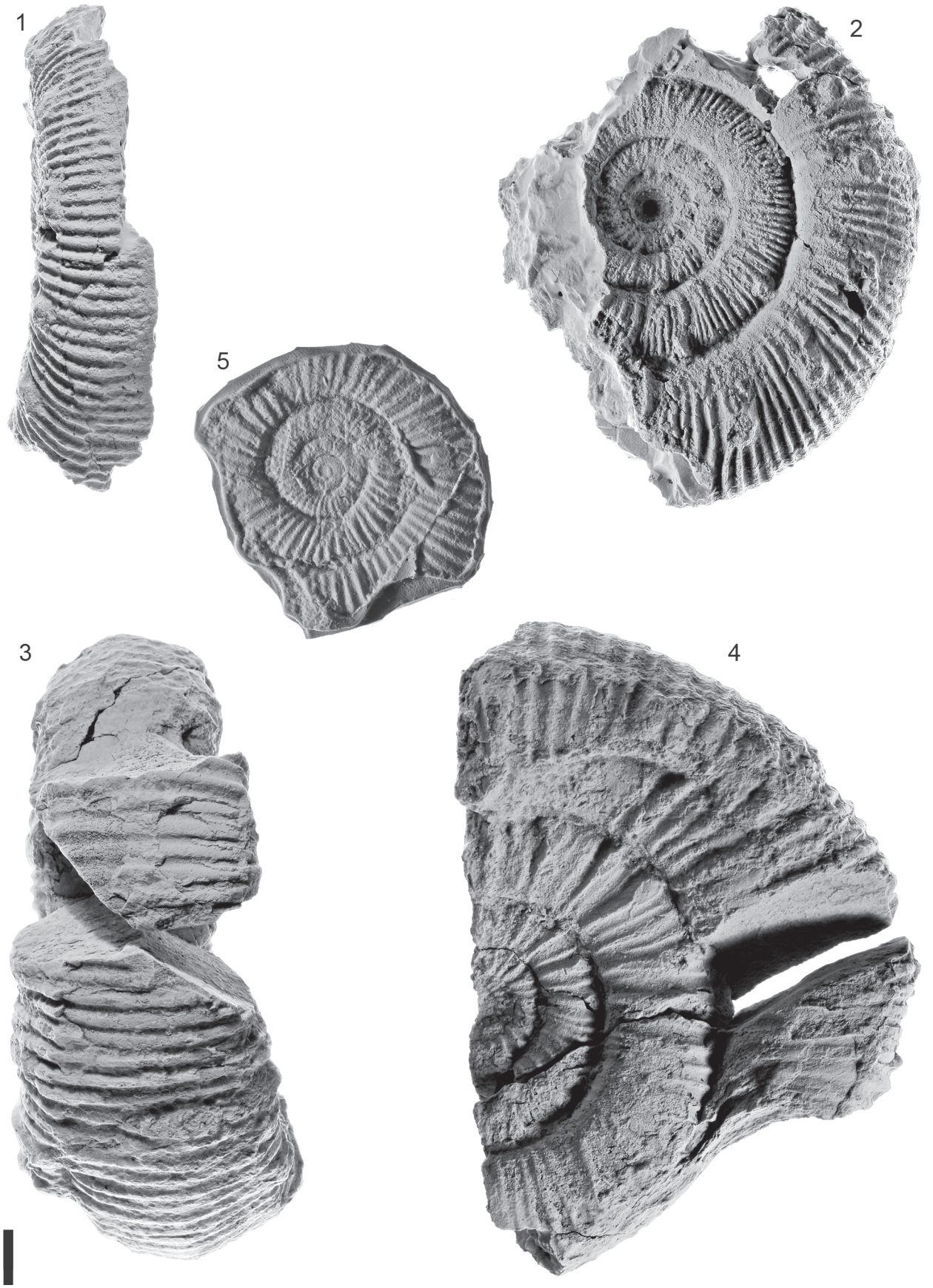
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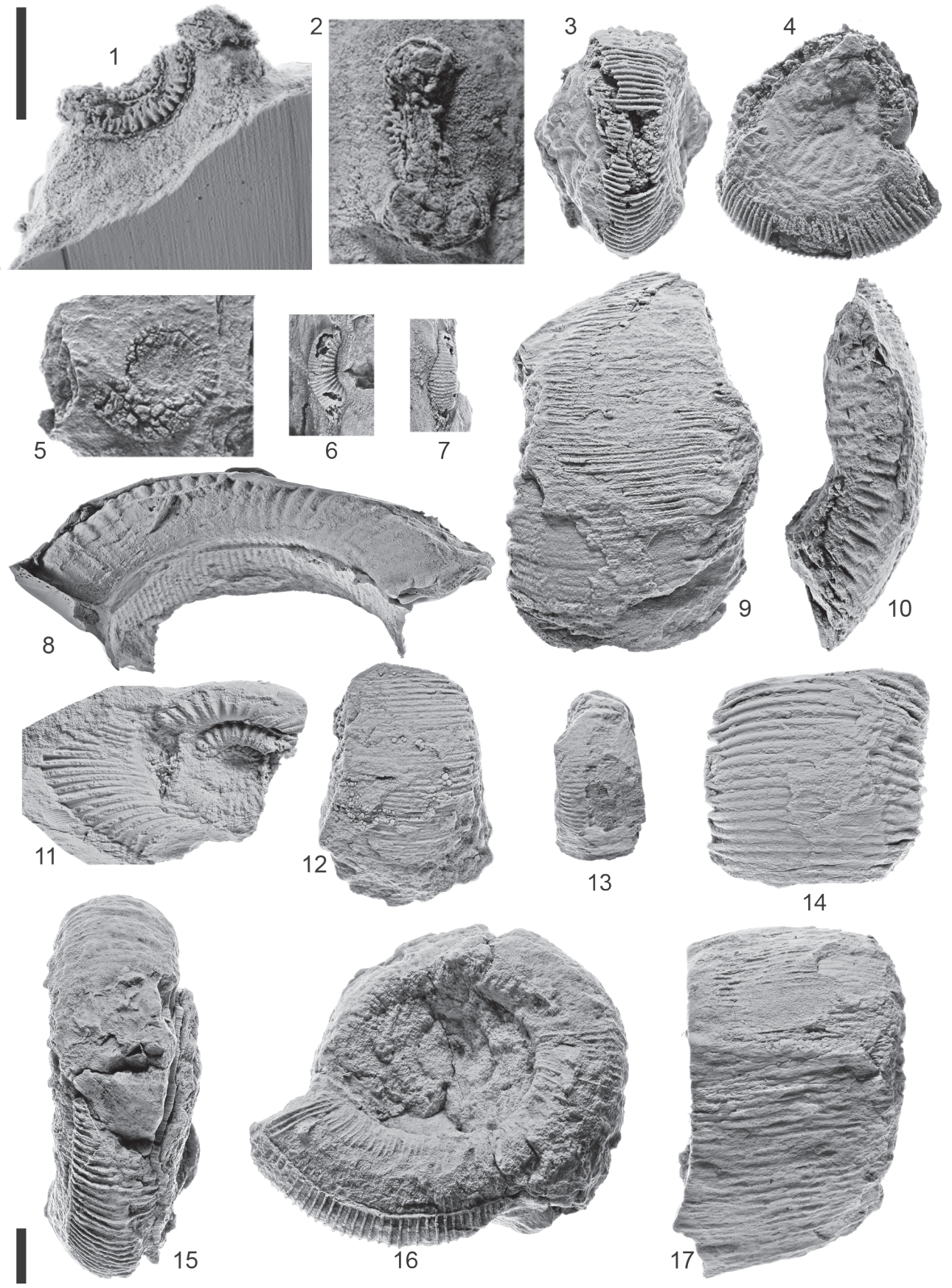
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PREPARATION OF MANUSCRIPTS

Bulletins of American Paleontology, the oldest continuously published, peer-reviewed paleontological journal in the Americas, seeks significant, larger monographs (> 50 printed pages, minimum 100 manuscript pages) in paleontological subjects or in neontological subjects that are strongly relevant to paleontological problems. Most contributions focus on systematics, placed in biostratigraphic, biogeographic, paleoenvironmental, paleoecological, and/or evolutionary contexts. Contributions have historically focused on fossil invertebrates, but papers on any taxon of any age are welcome. Emphasis is placed on manuscripts for which high-quality photographic illustrations and the large quarto format are desirable. Both single- and multi-authored (contributed proceedings) volumes are invited.

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