
Nomenclature of Lava Tube Features

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Abstract

In the past 75 years, works including well over 1,000 different names and phrases for features of lava tubes have been published. Inasmuch as there are only about 100 lava tube features arguably deserving distinction, that is far too many to go around. The excess consists of synonyms (the majority), ambiguous modifiers, oxymorons, conjectures, innocent misuse, double talk, and efforts to convey dimensions with terminology. While much of the redundancy is simply personal preference, sometimes without regard for the literature, certain characteristics of lava tubes generate more than their share of confounding terminology. This paper will focus on those aspects, the most troublesome of which is the matter of segmentation which even has political implications. Pitfalls are pointed out and suggestions offered for improving lava tube terminology.

Introduction

Prior to the early 1960s, U.S. literature regarding lava tubes was scanty and fragmentary. There are few excellent monographs about individual lava tubes—even fewer about groups of lava tubes—by and large, writers were more concerned with processes of volcanism other than lava tubes. For example, the fundamental connection between lava tubes and the emplacement of lava far removed from a vent escaped notice by all but a few. Except for the ubiquitous “lavacicles,”—named in 1923 but not successfully defined then or since—individual features of lava tubes were regarded as little more than curiosities. One of the first works to describe lava tube features in a comprehensive way was *Lava Beds National Monument: Outline of Geology*, by Lewis and Anderson, in 1936. Even though never published, several of the terms introduced therein are in use today.

In the early 1960s, with the advent of organized caving in the northwestern United States (where lava tubes outnumber other types of caves), exploration and description of them quickened. In 1963 description of lava tubes began in earnest with publication of *Caves of Washington*, by William R. Halliday. In this book, Halliday introduced a groundwork of lava tube terminology, most of which is still in use today.

Since then the number of recognized, significantly different features has increased modestly

and steadily as new discoveries were made, but the increase in terminology has been exponential. The habit of naming lava tube features after well known, everyday objects, without reference to morphology or genesis has created confusion. One person's curb is another's shoulder, another's bench, still another's apron, *ad infinitum*. Some terms such as “formation,” “lavacicle,” “dripstone,” “original,” and “balcony” have been so indiscriminately and unsystematically used that they are meaningless unless qualified. Furthermore, premature classification of features based on the study of a single lava field, even a single lava tube, produced theories and terms which, while conforming perfectly with the observations, conflict with observations of other lava fields and tubes.

Many terms currently in use were adapted from the much older family of terms used to describe features of solution caves, and rightly so. There are many directly interchangeable terms, e.g. collapse, coralloid, pillar, and sink. Many terms for depositional features have the same meaning regardless of cave genesis. However, some terms are not interchangeable, and a special problem is that many primary lava tube features so resemble their calcite cousins that they are often called speleothems. This is unfortunate, because there is an important distinction to be made, e.g. mineral stalactites (speleothems) form in both lava tubes and solution

caves, but stalactites composed of lava form only in lava tubes. A speleothem is a secondary mineral deposit formed in a cave, and cannot be composed of lava, some say, since it has a variable composition of many minerals.

Over 1,000 different terms and phrases for features of lava tubes have been published in the last 75 years. There are only about 100 lava tube features arguably deserving distinction. The excess consists of synonyms (the majority), ambiguous modifiers, oxymorons, conjectures, innocent misuse, double talk, and efforts to convey dimensions with terminology. Among the excess are the following:

Misuses:

“projected” when “inferred” is meant.

“linear” when “elongate” is meant – a surprisingly common misuse.

confusing “roof collapse” and “ceiling collapse.”

“channel”, when “river” or “stream” is meant.

“hydraulic” when “hydrostatic” is meant.

“upper tube” when “upper level” is meant

“cross section” when “profile” is meant, and vice versa.

“ice cave” when “glaciere” is meant (or “cave containing ice” if preferred)

“perennial ice cave” when “cave with perennial ice” is meant.

“permanent ice” when “perennial ice” is meant.

There is no such thing as permanent ice.

“remelt” (or remelted) when there is no way of knowing if remelting occurred.

Redundancy and Reiteration:

hot molten lava.

molten liquid.

cupola in roof.

vertical pit

downstream flow [of molten lava]

excessive use of “lava” as an adjective

Oxymorons:

segmented cave

collapsed channel

loose cinder, loose welded cinder, loose clinker

ceiling stalactite

underground lava tube, underground passage

Conjectures:

Former skylight, covered-over skylight.

Non Sequiturs:

partial natural bridge

secondary speleothem.

pre-lava

aa-pahoehoe transitional

filled skylight

Ambiguous Terms:

physically connected

map view.

old skylight.

“Intact” or “original” are often used but rarely qualified. Either term presupposes some condition that should be specified.

Problem Areas

Segmentation.

Lack of broad agreement regarding segmentation of lava tubes and systems increasingly spawns confusion about the nature of openings into lava tubes. A case could be made that there are only two kinds of openings: skylights, which are considered too small to segment a tube, and all other openings which do. This proposition is supported by Curl’s argument (1965) that all definitions of a cave which have ever been offered include the notion of rock overhead.

The principal aspect of segmentation, that of individual caves isolated from the tube or system by collapse, is troublesome. It directly affects the number of individual caves in a given province, a matter of some significance now that a U.S. Federal Cave Law requires that lists of caves be generated. It also directly affects the position of a given cave in long-cave lists, a matter of virtually no significance. Perhaps nothing illustrates the lack of a segmentation protocol more than the occasional use of the term “segmented cave.”

Speleothems.

“Speleothem” is a generally accepted, but frustrating term that differentiates an icicle formed in a cave from one formed under a highway bridge – and rests on the insecure definition of a cave. A good example of a term run amok. On the one hand, some speleologists contend that a mineral deposit formed in a mine, and morphologically and chemically identical to one found in a cave, is not a speleothem. On the other hand, there are those who would lump all mineral deposits, regardless of where found, including many rheologically-formed lava features, under the speleothem umbrella.

Openings.

The terms skylight, entrance, and opening are often used at the expense of truly descriptive terms. An “entrance” is not a lava tube feature. Neither is an “exit.” Both terms refer to a use of an opening, and often convey a false impression of the opening. For example, there are three openings into Ape Cave, in the Mount St. Helens National Monument. All three are skylights, and they do not segment the tube, yet only one is called a skylight. The other two are “entrances” – it would make as much sense to call them “exits” – because that’s where visitors go in and out.

Flow Features.

There is an entire class of forms created when lava freezes – lava flowstone, lava stalactites, lava stalagmites, and other things that resemble speleothems but aren’t – for which there is no attractive general term. “Rheologically formed” is an obvious candidate, but it is such a mouthful. “Primary” would be, it seems, appropriate, but as presently construed “primary” includes collapse features that occurred while lava was flowing. “Flow feature” is appropriate but by no means enjoys universal use.

Recommendations

- Use existing terms when possible. Borrow from solution cave nomenclature if appropriate. For example, a speleothem may be found in any type of cave. Sinks, pillars, sand castles, stalactites, stoping, and so on are common to solution caves as well as lava tube caves. The glossary accompanying this paper includes most former usage, but nothing will substitute for searching the literature.
- Terms should not be used to denote dimensions: for example, one writer uses tubelet for little tubes.
- If a term has to be manufactured, try to make it as expressive of the morphology and composition of the feature as possible. Avoid using names of everyday, commonly encountered objects, or names of persons living or dead.
- Use lava as an adjective only to distinguish from similarly-shaped features of different composition in other types caves. Excessive use of lava, pahoehoe, and basalt – as adjectives – is uncalled for in regard to lava tubes.
- Don’t allow point of view to influence terminology: For example, skylights (there’s that term again!) are usually seen as skylights from inside the cave, but often as pits when viewed from the surface.
- Don’t confuse roof and ceiling.
- Avoid speculative terms or speculative use of terms, e.g. “remelt.” Most of what has been called remelt was certainly fluid at one time, but examples that can be positively identified as remelt are few and far between.

Glossary of Vulcanospeleology

The following Glossary of Vulcanospeleology was culled from over 1,000 terms found in the works of about 100 different authors. The reference list is by no means exhaustive – it gives only references to pertinent works rich in terminology. Those works in turn provide reference to much other literature pertaining to lava tubes.

I have included features apt to be associated with lava tubes, and some having similar meaning regardless of cave type, and avoided redefining anything in other geologic senses. Though not specifically relating to lava tube features, the following terms are included because they are not universally understood and often misused: ceiling, cross section, map length, plan view, profile, roof, traverse length, and others. “Lava” is frequently used as an adjective to avoid conflicts with morphologically similar forms (principally speleothems) found in other kinds of caves.

Aka (Also known as): These are the other 900-odd names for the same thing, as nearly as I could discern. Many of these terms are clearly synonyms, but equally as many have not even approached common usage. Many have been used only once, and then not clearly defined. I expect that some readers will be unhappy because their favorite term(s) were not listed prominently. Please let me know. If this glossary does no more than narrow the focus on lava tube nomenclature, I will consider it time well spent.

The illustrated glossary (see references) should be available by the time this paper is published. It includes photos of nearly all the principal features, and an alphabetized list of all terms, cross referenced to the source literature.

Glossary of Lava Tube Features

Abbreviations used: Aka = Also known as, Cf = compare with, e.g. = for example, i.e. = that is, Syn = synonym.

AA. A type of lava flow with a rough, jagged, spinose, clinkery, and generally irregular surface. Fully developed aa is unusual inside lava tubes. Pronounced ah ah, as in father. Etymol: Hawaiian. An expletive of pain when walking barefoot on such lava. Cf: cauliflower aa, pahoehoe.

ALCOVE. A relatively small recess in the wall of a lava tube. Cf: cupola. Aka: balcony, lateral pocket.

AMBERAT. A varnish-like deposit composed primarily of the residue of rat urine. It ranges in color from clear yellow through red, brown, mahogany to jet black. It has been reported only in dry caves. Etymol: Resembled amber, smelled of rats. Type material from Sheep Canyon Cave, Montana. Aka: ratite.

APRON. A top surface that slopes down inward from a lava tube wall. Aka: sloping alcove, sloping apron, sloping lava bench, sloping lava ledge, sloping-top bench.

BENCH. A bank along the side of a lava tube. Distinction between benches, shelves and levees isn't always clear. In general, benches are essentially rectangular in cross section, and join both floor and wall; levees are usually attached to the floor and separated from the wall, but may be attached to the wall at considerable distance above the floor; shelves are attached to the wall and overhang. Cf: curb, terrace. Aka: balcony, basalt bank, "B" type lava ledge, bench line, flow bench, flow ledge, flow level, flow shelf, lateral lava shelf, lateral ledge, lava terrace, lava tunnel terrace, ledge, lining curb, perched balcony, perched lava bench, shelf, shoreline, shoulder, side walk, spatter bench, terrace, tide bench, tide mark.

BLISTER CAVE. A lava blister that can be entered by a human.

BLOCK RAMPART. A ridge or wall of loose blocks adjacent to or surrounding a collapse sink or collapse trench; the remnant of a tumulus which collapsed back into the lava tube from which it came. Cf: pressure ridge. See also: raised-rim crater. Aka: elevated rim, hydraulic rampart, rampart, tilted rampart.

BOTRYOID LAVA STALACTITE. A cluster of short, branching lava helictites that resembles

a bunch of small grapes. Aka: grape type lava stalactite, knotted string stalactite.

BRANCH TUBE. (or simply "branch") (a) Either of the branches at a fork of a lava tube. (b) The place where a tube forks. See also: distributary tube, effluent tube. Aka: bifurcate, branched, once-branched, secondary lava tube, side passage, subordinate tube.

BREAKDOWN. A general term for broken pieces of a lava tube's roof or walls—the product of collapse—applied to individual blocks, accumulations and various structures resulting from re-incorporation of loose pieces in fluid lava. See pillar, rafted breakdown. Aka: basalt rubble, breakdown block (a single piece), breakdown rock, collapse block, collapse breccia, collapsed roof block, collapse rubble, pre-lava [sic] collapse breccia, rubble.

BREAKDOWN FLOOR. A cave floor that is mostly covered with breakdown.

BREAKDOWN JAM. An accumulation of rafted breakdown lodged in such a way as to plug a tube. Identity may be totally masked by lining(s), especially on the upstream end, but individual pieces often remain discernible at the downstream end. Cf: lava seal. Aka: breakdown plug, breakdown seal, floor jam, jam of jostled pahoehoe blocks, jam of rafted blocks, lava ball, lava block jam, lava-carried breakdown pile, plug.

BRIDGE. A remnant of a lava tube roof no wider, measured parallel to the tube axis, than the width of the tube it spans. Aka: arch, balcony, lava bridge, lava span, natural bridge, span.

BULBOUS LAVA STALACTITE. A lava stalactite that is significantly thicker at the bottom than at the top. Known examples appear to be small, hanging lava toes. Aka: bulbous pendant, lava stalactite, push out lava stalactite.

CAULIFLOWER AA. A type of lava transitional between pahoehoe and aa, the surface of which consists of closely-spaced lumps that range from about 5 to 30 cm across, that are **firmly bonded** to the underlying lava. The outer skin of the "flore" is typically knobby, bumpy, or even spiny. Cauliflower aa is quite common in lava tubes on the surface of lava falls, floors, levees and tongues, and often entrains rafted breakdown, broken crusts, lava stalagmites, and anything else that fell on it prior to congealing. It is frequently modified on a broad scale

- with billows and ropes. Gradational to clinker (loose pieces). Cf: aa, clinker, spiny pahoehoe. Aka: aa-pahoehoe [*sic*] transitional, clastolith, clinker, clinkery pahoehoe, clinkery pahoehoe ripple, frothy pahoehoe, granular, granularly surfaced pahoehoe, pahoehoe to aa surface, scraggy veneer, spiny pahoehoe, tessellated, transitional pahoehoe-aa.
- CAULIFLOWER AA FLOOR.** A lava tube floor which is predominantly cauliflower aa. Aka: clinkery floor, klinkery ripple.
- CAVE.** "A naturally occurring void, cavity, recess, or system of interconnected passages which occurs beneath the surface of the earth or within a cliff or ledge . . . and which is large enough to permit an individual to enter . . ." (Federal Cave Resources Protection Act of 1988). Federal law notwithstanding, there is no commonly accepted definition of a cave. For example, one popular elastic definition requires that the cave extend beyond the twilight which, by definition is virtually undefinable. See also (the limitations of): lava tube cave. Aka: cavern.
- CAVERNOUS WEATHERING.** Chemical and mechanical weathering which results in disintegration of lava tube linings, and associated cliff-like surface features, in semi-arid regions. The usual result is a range of features remarkably similar in appearance to speleogens in solution caves, and some peculiarities like hollow breakdown blocks. Limited study to date indicates that the phenomena is the "cavernous weathering" described in Bates and Jackson (1987) – also known as "fretwork weathering" or "honeycomb weathering." The cavities so produced, including hollow boulders, are known as "tafone" (ta-fo'-ne). Aka: differential weathering, groundwater erosion, lava weathering, salt replacement weathering, subterranean weathering, weathered form.
- CEILING.** The upper inside surface of a lava tube or multiple level thereof. Cf: floor, roof. Aka: back.
- CHOCKSTONE.** A lava block, or mass of consolidated debris, caught in a passage constriction. Subsequent modification by continued lava flow often obscures the origin, e.g. chockstones are often the nucleus of a pillar. Aka: lava ball, meatball, perched lava ball.
- CLINKER.** Small (usually less than one foot in diameter), loose fragments of lava with rough, jagged surfaces. Clinker is commonly found on the floor and behind linings of lava tubes. It is a primary feature and should not be confused with pieces of breakdown which have fractured surfaces and may be either primary or secondary. See also: clinker floor. Aka: autobrecciated lava, flow breccia, flow-top breccia, loose clinker [*sic*].
- CLINKER FLOOR.** A floor on which clinkers predominate.
- COLLAPSE.** The mechanical failure of parts of a lava tube to withstand gravity. Collapse, like many other modifications, may be primary or secondary. See also: breakdown, collapse sink, collapse trench, stoping. Aka: breakdown, cave-in, caving, post-volcanic (roof) collapse, rockfall, unraveling.
- COLLAPSED LAVA POND.** A shallow surface depression with gently dipping sides, resulting from drainage of a lava pond. Typically the pond crust settles gently downward leaving a relatively even basin broken only by tension cracks. Aka: sag, sag basin, shallow collapse basin.
- COLLAPSE SINK.** An essentially circular, usually steep-sided, surface depression resulting from collapse into an underlying cavity, e.g. a lava tube. Cf: collapse trench. Aka: breakdown, collapse basin, collapse depression, collapse hole, collapse pit, jameo.
- COLLAPSE TRENCH.** An elongate, usually steep-sided and sinuous, surface depression resulting from collapse of a lava tube roof. Cf: trench. Aka: breakdown, breakdown trench, broken surface tube, caved-in trench, collapse depression, collapse pit, jameo, lava tube collapse depression, rift, surface trough.
- COLUMN.** (a) A speleothem formed by joining of a stalactite and corresponding stalagmite. Rare in lava tubes. (b) A lava stalagmite reaching the ceiling. Only two examples of the latter have been described (Halliday, 1967; Ogawa, 1980). Cf: pillar. Aka: mitertite, pillar, stalacto-stalagmite.
- COMPOUND [features].** An adjective denoting a series of similar features. Multiple benches, flow lines, and levees are commonly found overlapping, in stair step fashion, and may be termed compound [features], e.g. compound benches. Aka: "C" type lava ledge, multiple levees, set of steps, stair step, successive lava marks, successive level marks.
- CONTRACTION CRACK.** A narrow, elongate crack caused by contraction of lava as it cools. Contraction cracks are abundant in lava tubes,

- usually limited to a single flow unit, and vary in width from microscopic to several centimeters, the wider often found in floor units of considerable thickness which cooled slowly. Aka: cooling crack, contraction fissure, contraction fracture.
- CONULITE.** The compacted and/or mineralized lining of a drip hole in sediments. Conulites impregnated, and lined, with calcite have been identified, but other minerals seem suitable as well. When exposed by erosion of the surrounding unconsolidated material they are strikingly apparent. Aka: antistalagmite, mud cup, splash cup.
- CORALLOID.** A general term for a nodular, globular, botryoidal, or coral-like speleothem. Commonly found on projections of the ceiling, wall, or floor where a nucleus for growth is provided and evaporation is enhanced. Siliceous and marginally calcareous coralloids have been identified in lava tubes, mostly in semi-arid regions. A wide range of colors has been noted. Aka: cave coral, cave grape, concretion, coral, coral lava, coralloidal opal, globulite, knobstone, lava coral, lava lace, opal coral, pisolitic concretion, popcorn. (A variant in which spines of lava project beyond the speleothem is known as lava lace.)
- CROSS SECTION.** The outline of something cut off at right angles to an axis, in the speleological context, the transverse outline of a cave, stalactite, etc. at a specified point. Cf: profile. (Some of the adjectives used to describe the cross section of lava tubes are: arched, bell-shaped, bulging, ceiling channel, channeled, circular, cutbank, dome-shaped, double tube, elliptical, figure-8, flat-roofed, gable-shaped, gothic (arch), hemispherical, horizontally oval, hour-glass, irregular, keyhole, moorish dome, multi-storied, multi-tiered, mushroom, oval, overcut, semi-circular, shell-shaped, skull-shaped, stacked, triangular, undercut.)
- CRUST.** (a) The hardened exterior of a body of lava. Inside lava tubes, crusts form where heat loss is greatest, typically near openings to the surface. See also: lower level roof. Aka: balcony, initial roof stratum, tube-in-tube. (b) A form of speleothem. Crusts are unusual in lava tubes, except for gypsum crusts in lava tubes in arid locales.
- CUPOLA.** A recess in the ceiling of a lava tube. Possible origins of a cupola are: a cavity created by collapse, inflation of the roof by gas or lava pressure, or the roofed-over site of a former tube overflow. See also: rise chamber. Cf: alcove. Aka: breakdown dome, ceiling dome, covered skylight [*sic*], dome, filled skylight [*sic*], former skylight [*sic*], old skylight, overflow dome, roofed-over skylight [*sic*], standpipe chamber.
- CURB.** A low, narrow bench. Aka: curb lining, lining curb, small flow edge ridge.
- CUTBANK.** The concave wall of lava tube meander bend that is frequently the site of a recess or alcove eroded by an impinging lava stream. Cf: slip bank. Aka: meander cutbank.
- CUT-OFF BRANCH.** A lava tube cut off by collapse, plugged with congealed lava, or left hanging above subsequent flows in a main tube. Cf: perched tube. Aka: former branching, once-branched, once-interconnected.
- DEFLATED FLOOR.** A floor crust which collapsed following withdrawal of underlying lava. Cf: inflated floor.
- DIP-LAYERED STALACTITE.** A lava stalactite composed of highly vesicular, concentric layers, apparently resulting from repeated inundation by fluid lava. They are rare because of the special conditions required for their formation. Cf: spatter stalactite. Aka: candle-dip stalactite, coarse lavacicle.
- DISTRIBUTARY TUBE.** A lava tube flowing away from a main tube that does not return (as a re-entrant tube). Cf: effluent tube. Aka: branching secondary tube, divergent branch, egressive branch, feeder tube, major distributary, minor lava tube.
- DRAINBACK.** An opening through which a lava tube overflowed onto the surface, usually distinguishable by obvious patterns of lava flowing back into the tube. Other indicators are the absence of fractured surfaces around the lip of the opening and/or patches of red, oxidized linings adjacent to the opening. Aka: drainback feature, influx, lava retreat, roof rupture, skylight.
- DRIBLET SPIRE.** A smaller type of hornito built of imbricating clots of lava feebly rather than violently ejected. Large examples in Idaho (Greeley, 1971) averaged 12 feet in height and 5 feet in diameter. Hornitos can be much larger. Aka: driblet cone, lavacicle, small rootless volcano.
- DRIP HOLE.** A vertical hole eroded by dripping water. Dripping water creates drip holes in sediments, soluble rocks, and mineral deposits. Drip holes that penetrated mineral deposits to

- erode underlying bedrock have been described. In sediments they are usually tapered, with a roughly circular transverse cross section. They may be slightly tilted, or considerably elongated in transverse cross section as a result of prevailing air movement on dripping water. See also: conulite. Cf: sand castle. Aka: drill hole, drip cup, drip-drilled mud pit, drip-formed depression, splash cup, splash hole.
- DRIP LINE.** The line defined on a cave floor at an opening where surface water drips from overhanging rocks. Because overhangs are vulnerable to erosional processes—especially ice wedging—the drip line is often marked by a wall of recently-fallen blocks. The drip line is also a valuable reference point for surveying and resolution of segmentation dilemmas.
- DRIPSTONE.** A speleothem precipitated from dripping water, abundant in solution caves but unusual in lava tubes. Cf: flowstone, lava flowstone.
- EFFLUENT TUBE.** A lava tube flowing away from a main tube. Cf: distributary tube. Aka: divergent branch, egressive branch, side tube.
- ELEPHANT'S FOOT STALACTITE.** A lava stalactite which had its growth terminated on an obstruction later removed. Seldom more than a few centimeters long because they usually occur between separated roof linings. Cf: tubular lava stalactite. Aka: club foot pendant.
- ENTRANCE (Cave).** An opening into a cave large enough to admit a human. Natural entrances to lava tubes are either residual openings or are created by collapse to the surface. Aka: collapse entrance.
- FALSE FLOOR.** A lower level roof (usually a crust) over an underlying passage too small to enter. Aka: hollow floor, secondary floor, subsidiary floor, tube-in-tube.
- FESTOON.** An arcuate fold or ridge formed by gravity-induced slumping and wrinkling of lava flowstone. Festoons are common on lava tube walls. Cf: ropy lava. Aka: arcuate plications, drapery of lava dripstone, festooned ropy pahoehoe, wrinkle.
- FILLED LAVA TUBE.** A segment of a lava tube that is filled with hardened lava, as a result of failure to drain or invasion by a subsequent lava flow. Aka: reactivated system.
- FLOOR (lava tube).** The lower inside surface of a lava tube or multiple level thereof. (For example, the top surface of a lower level roof dividing levels of a multilevel tube is a floor.) Cf: ceiling, roof. Floors may be the completely exposed, aa-congealed surface of the last lava to flow in the tube or covered with debris, like clinkers, breakdown, fragments of plates and linings, or composites thereof. Such coverings range from an occasional piece to elongate entrainments several feet thick, often rafted along, conveyor-belt fashion. Infrequently, floors are covered to some degree with sand (usually tephra), sediments and other deposits, especially near openings to the surface. The character of aa-congealed floor surfaces depends on whether the lava was moving or quiescent when it congealed, and its state of transition from pahoehoe to aa. Surfaces range from very smooth pahoehoe (as smooth as a sidewalk) to, rarely, full-blown aa. Cauliflower aa predominates. On a broad scale, patterns revealing movement are common regardless of the surface, e.g. billows, ropes, contraction cracks (as well as tension cracks), levees, tube-in-tube, and so on. See also: breakdown floor, cauliflower aa floor, clinker floor.
- FLOW FEATURE.** A collective term for features formed by movement of molten lava. Aka: rheogenetic feature.
- FLOW LINE.** An elongate projection or groove along the wall or floor, too small to significantly affect the tube's cross section. Flow lines along the wall typically mark interruptions of receding lava flow and often accumulate in stair-step fashion (see compound). Ordinarily they are gently dipping down-tube, reflecting the lava stream's hydrostatic grade, but standing waves may reverse the dip locally. Dips up to 15 degrees have been noted. Cf: strandline. Flow lines on the floor typically demarcate currents, eddies, and zones of shear in the flow. Aka: bathtub ring, curbing, "D" type shelves and ledges, flow crest line, flow mark, former lava level, frozen shore line, high lava mark, high stand, horizontal ridge, lateral flow groove, lateral line, lava mark, longitudinal deposit, miniature lava bench, minor ledge, multiple lateral groove, shear, stripe, shoreline, temporary surface level, tide mark, wall groove, wall ridge.
- FLOWSTONE.** A speleothem deposited by flow of water films, common in limestone caves. In lava tubes, ice flowstone in massive accumulations is common but rarely do other minerals accumulate (as flowstone) in excess of films or coatings. Cf: dripstone, lava flowstone.

- FLOW UNIT.** A successive but essentially contemporaneous layer or unit of lava constituting a single larger flow. Each unit represents a separate surge or sheet of liquid lava, all of which are part of the same eruption. Thickness ranges widely, from centimeters to several meters.
- FORMATION.** (a) A geological term for the basic or fundamental unit by which rocks are grouped in geologic mapping. (b) Any kind of a distinctive or unusual natural feature arising from processes of deposition, molding, or erosion, hence it has been indiscriminately applied to many of the fascinating features of caves. Aka: decoration.
- FUMAROLE.** A gas vent, sometimes associated with spattering of lava. Cf: hornito.
- GLACIERE.** A French word for subterranean ice. It was tentatively proposed by Balch, in 1900, as a term for a cave – in rock – that contains ice. (Not to be confused with “glacier cave” which is a cave in a glacier.) Cf: ice cave. Aka: cave of perpetual ice, cave of transient ice, freezing cave, freezing cavern, ice cave.
- GLAZE.** A thin, smooth, vitreous surface commonly found on lava tube features, especially on lava flowstone. Some researchers believe that convection and radiant heat from the lava flow alone are enough to glaze even hardened basalt. Others believe glaze is, to some degree, remelt but could only occur in a blast-furnace-like atmosphere augmented with burning gases. Aka: flash glaze, glassy surface, remelt glaze, sheet of glassy lava, thin lava veneer.
- GROOVED LAVA.** Grooves, striations, and gouges produced by movement between bodies of lava, of which at least one is still plastic. Aka: ceiling groove, dragged (lava), drag mark, flow groove, scratch marks, striation.
- GUTTER.** A trough-like, elongate depression between a levee, or tongue, and adjacent wall, the bottom of which may be lower or higher than the medial floor. Cf: lava channel. Aka: flow channel, lateral gutter, lava channel, shear, slot, trough, wall gutter.
- HORNITO.** A conical structure built up by clots of fluid lava ejected through an opening in the crust of a lava flow. Common on the roof of a lava tube and occasionally found on floors. Usually retains the central conduit. Cf: driblet spire, fumarole, rootless vent. Aka: agglutinate spatter cone, blow hole, blowout, blow pipe, chimney, driblet cone, entrance, fumarole, pneumatogenetic explosive cave, rootless spatter cone, rootless volcano, secondary spatter cone, secondary vent, spatter vent, small volcano, spatter cone, spatter cone pit, volcano without roots.
- ICE CAVE.** A cave in ice. The term is, however, commonly applied to any type of cave that contains ice. See: glaciere.
- ICE HORIZON.** A sharp, thin, rimstone marking a former ice stand line in a lava tube. They are seldom more than a film, and typically so inconspicuous that they are only apparent on more or less uniform surfaces at eye level.
- INFLATED FLOOR.** A floor crust ruptured by injection of lava beneath it. Typically, the crust splits near the center and along the walls, creating plates tilted upward in a form resembling a pressure ridge. Cf: deflated floor. Aka: arch, bread loaf ridge, floor inflation, heaved-up blocks.
- ISLAND.** An obstruction (usually a piece or raft of breakdown) “run aground” on the floor of a lava tube, surrounded and often modified by passing lava flow. Aka: bubble, concentric, depositional concentric, lava ball, splash ring. Cf: rafted breakdown.
- KIPUKA.** An island of older rock surrounded by younger lava.
- LAVA.** A general term for a molten extrusive, most commonly applied to surface flows from a volcanic vent, also for the volcanic rock that solidifies from it.
- LAVA BLISTER.** A hollow, surficial swelling of the crust of a lava flow, puffed up by gas from within or beneath the flow. Blisters range from tens of centimeters to several meters in diameter. Blisters noted on lava tube floors range in diameter from a few millimeters to tens of centimeters. They have a thin, vitreous skin, and may be empty or filled with nested layers of frothy lava. They may be found singly or in wall-to-wall accumulations, making non-destructive passage virtually impossible. See blister cave. Aka: blister, gas blister, lava bubble, pneumatogenetic expansion cave.
- LAVA CAVE.** A general term for any cave within lava, regardless of how formed. See also: cave, lava tube, lava tube cave. Aka: volcanic cave.
- LAVA CHANNEL** (or simply “channel”). A long open trough, on or in a lava flow, occupied or formerly occupied by a lava stream. Commonly, channels bounded by levees – or walls built up of congealed overflows, splashes, and spatter –

are perched above adjacent surfaces. Channels inside lava tubes are typically much smaller and closely follow the tube centerline. Cf: gutter. Aka: channel, contraction valley, feeder channel, gutter, lava brook, lava gutter, lava river, open lava channel, river, shoot [*sic*], trough.

LAVACICLE. A general term that has been applied to nearly anything that protrudes into a lava tube, even stalagmites. It is ambiguous unless qualified. [The word originated with Phil Brogan, a prolific writer about Oregon's natural history, who applied it to both stalactites and stalagmites. It is first known to have appeared in print in 1923 (as "lava-cicle"), in Ira Willams' "The Lava River Tunnel," in reference to the tubular lava stalactites which were once abundant there.]

LAVA DAM. A levee across a lava tube. Aka: dam.

LAVA FALL. A precipitous drop in the floor of a tube over which lava flowed. Aka: cascade, dam, fall, lava drain, rapids.

LAVA FLOWSTONE. A fluid layer of lava on the boundary surface of a lava tube. Commonly, a fluid layer remains when an intratubal stream of lava recedes. A fluid layer may be acquired by remelt, or may be deposited by spatter. Also, a general term for lava forms resulting from its flow. Cf: dripstone, flowstone. Aka: dripstone, lavacicle, dribble, drip lava, film of liquid lava, flow of film, flowstone, lava dripstone, lava formation, lava speleothem, liquid lining film, primary drip, skin of lava, solidified drips of once fluid lava, vertical flow lines.

LAVA HELICTITE. A cylindrical—often partially tubular—extrusion, usually contorted and jointed but sometimes linear, unaffected by gravity. Many resemble tubular lava stalactites—with which they occur in combinations—in all respects except that they are not gravity-controlled. Most emerge abruptly from the host surface, apparently extruded in response to gas pressure, and may grow at either end. Ranging in size from tiny, five-millimeter-diameter, twig-like branches up to the familiar diameter of tubular lava stalactites. They emerge from all kinds of linings, other helictites, stalactites, and even from fractured surfaces. Aka: eccentric, eccentric stalactite, erratic, irregular tubular lavacicle, lavacicle, worm, worm stalactite.

LAVA LAKE. A standing body of usually basaltic fluid lava in a volcanic crater or depression. The

term applies to solidified and partly solidified stages as well as to the fluid, active lava lake.

LAVA ROSE. A broad, low form resembling the bloom of a rose. There are two distinct types which, while similar in appearance, originate quite differently.

(a) Extruded Roses are created by successive, concentric extrusion and rupture of lava bubbles, the result resembling a rose bloom. Averaging about eight centimeters in diameter, they seldom exceed five centimeters in height. Like lava bubbles, they are uncommon and extremely fragile. Aka: minicano.

(b) Stalagmite Rose. The blunt, cup-shaped top of a lava stalagmite, flattened by the impact of relatively large clots of lava falling from considerable height, the result resembling a flower bloom. Also resembles a small dribble spire but lacks the central conduit. Aka: lava puddle, pancake lava stalagmite, puddle, rose cicle.

LAVA SEAL. A point where a lava tube is completely blocked by congealed lava Cf: breakdown jam. See also: filled lava tube, lava sump. Aka: intrusive lava seal, lava fill, lava plug, plug, sump, viscous plug.

LAVA SPRING. Lava welling up into a tube, typically on the downstream side of a lava sump. Aka: upwelling, upwelling source of lava.

LAVA STALACTITE. A stalactite consisting of a molten or solidified mass of lava. All lava stalactites originate in the molten state. Some harden, without modification, from the liquid. Others are distorted externally (by gas currents) or internally (by vesiculation) prior to hardening. Still others accumulate layers of lava flowstone or spatter. Transverse cross sections range widely, from circular (See teat stalactite) to extremely elongate (See rib). See also: botryoid lava stalactite, bulbous lava stalactite, dip-layered stalactite, elephant's foot stalactite, pipe stem stalactite, shark tooth stalactite, soda straw stalactite, spatter stalactite, teat stalactite, tubular lava stalactite. Aka: accreted form, cicle, basaltic ornamentation, common stalactite, drip cicle, drip lava stalactite, drip decoration, dripstone stalactite, festoon, glaze stalactite, lava candle, lavacicle, lava drip formation, lava drip, lava cicle, lava formation, lavacicle stalactite, lava speleothem, lavatite, ornamentation, primary ornamentation, remelt stalactite, solidified drips of once fluid lava, speleothem, stalactite of basalt, stalactitic

droppings of lava, syngenetic basalt stalactite, tapered stalactite. Cf: stretched lava projection.

LAVA STALAGMITE. A vertically oriented accretion of droplets and dribbles of semi-solid and solid lava, occurring in a wide variety of shapes and sizes ranging from broad, low lava roses rising barely above the floor, to giants over two meters high. They are initially associated with a ceiling or wall structure which dripped (a low point, stalactite, etc.), but usually the host surface moves or is overridden, causing a numerical disparity between stalactites and stalagmites. See also: column. Aka: basaltic ornamentation, common drip stalagmite, cored form, driblet spire, drip accreted stalagmite, drip-formed stalagmite, drip mound, drip stalagmite, floor cicle, globular lava stalagmite, lavacicle, lava formation, lavamite, lava speleothem, little people, little people formations, multiglobular stalagmite, ornamentation, pancake lava stalagmite, primary ornamentation, speleothem, stalagmite lavacicle.

LAVA STREAM. A body of lava flowing in a lava channel.

LAVA SUMP. A local depression in the floor where lava drained from a lava tube. Although most lava sumps are lava seals at the down-tube end of a lava tube segment, occasionally they occur elsewhere, for example where lava drained into a lower level. Aka: inverted siphon, inverted spoon, lava fill, lava siphon, siphon, siphon plug, solidified lava sump.

LAVA TOE. A bulbous mass of lava in tough, seemingly elastic skin which emerges from the crusted front of a relatively slow-moving pahoehoe flow, and is a primary means of expansion of pahoehoe lava flows. Toes vary widely in size, up to several meters. Coalescence of toes is thought to be a primary means by which distributaries of lava tube systems advance. Toes inside lava tubes are not common and limited in size.

LAVA TREE. A lava tree mold that projects above the surrounding surface.

LAVA TREE MOLD. A cavity inside a lava flow formerly occupied by a tree engulfed by the flow. Many, perhaps most molds are substantially altered as the tree burns. Frequently the mold preserves the craze pattern of burned wood in minute detail. Occasionally tree molds are exposed inside lava tubes. Cf: lava tree.

LAVA TUBE. A conduit formed of hardened lava, on or within a lava flow through which lava flows to an advancing flow front, also a cavernous segment of the conduit remaining after flow ceases. Only two variants, surface tube and tube-in-tube are literally tubes. Cf: cave, lava cave, lava tube cave, lava tube system. See also: branch tube, cut-off branch, distributary tube, effluent tube, filled lava tube, main tube, master tube, perched tube, re-entrant tube, surface tube, tributary tube, unitary tube. Aka: basalt cave, drain pipe of solid lava, lava cave, lava tublet [*sic*], lava tunnel, rheogenetic surface cave, true lava cave, tublet [*sic*], tunnel, volcanic flow drain. A lava tube may be active (carrying fluid lava), abandoned (see primary), filled with solid lava (did not drain), reactivated (invaded by a subsequent eruption), or filled to some degree with deposits like sand or water.

LAVA TUBE BOXWORK. Pairs of intersecting blades projecting from tube ceiling or walls which appear to be of two possible origins. (a) Preferential remelting on or adjacent to contraction cracks. Related to melt-out pocket. See also: remelt. (b) Preferential cavernous weathering adjacent to contraction cracks. Aka: boxwork.

LAVA TUBE CAVE. (Or simply "lava tube.") A specific lava tube, or segment of a lava tube that qualifies as a cave. (Distinction between individual lava tube caves is complicated by progressive collapse creating new openings to—or segmenting—known caves, and incremental discovery, but most of all by lack of consensus about the effect of segmenting features. For example, the usual type of opening, a collapse, often creates more than one opening and the question arises: is the sink a part of a single cave, or does it separate two caves? The International Union of Speleology has suggested a partial resolution: if the sink's largest dimension measured horizontally exceeds its depth, the tube is segmented, resulting in multiple caves. All parts of a segment which can be traversed by an individual, without passing through a segmenting sink, constitute an individual cave. (International Union of Speleology, 1979.) Aka: lava-tube cave, lava tube system, open tube.

LAVA TUBE SLIME. A relatively thin layer of moist, algae-like, sometimes gelatinous material that locally coats the walls and ceilings of lava tubes. Limited study indicates that a major

component is bacteria of one sort or another, which account for the wide range of colors reported. Under certain conditions the slime becomes hydrophobic causing water beads to form, and rendering the surface highly reflective—the white or silvery appearance often reported.

LAVA TUBE SYSTEM. A distributive network of lava tubes that is characteristic of tube-fed pahoehoe flows, and the principal means by which such flows are so widely and thinly spread. While systems range in complexity from unitary tubes to complicated networks of parallel, overcrossing and re-entrant tubes, they are usually broadly dendritic in pattern, with an identifiable master tube. For obvious reasons, in-depth study of lava tube systems is virtually limited to inactive examples. An inactive lava tube system is a series or network of lava tube caves, collapse trenches, and other characteristic features, all of which, it is reasonably certain, are part of contemporaneous flow units. (Characteristic features, roughly in order of their probability from proximal to distal extremities of a system are: collapses, hornitos, skylights, rootless vents, tumuli, and pressure plateaus.) Aka: axial conduit network, axial tube system, braided complex, braided pattern, chain of collapse trenches, chain of large lava tubes, conduit system, distributary pattern of channels, distributary system, interconnected system, internal artery system, lava cave system, lava distributary system, lava tube, line of breakdowns, line of large feeder tubes, line of major breakdowns, major cave system, major lava tube, master drainage system, master lava tube system, repeatedly branching, rift, set of lava tubes.

LAYERED LAVA. Successive thin flow units and near-surface zones of vesiculation within the thin flow units. Commonly associated with a leveed channel or semitrench. Aka: lamina, multi-lamination.

LEEVEE. (a) Surface. A retaining wall of hardened lava along the side of a lava channel or lake, built up incrementally by successive overflow, overthrusting of lava crusts or blocks, or spatter. (b) Intra-tubal. A free-standing lateral remnant of a lava tongue or flow caused by cooling along the edges and subsequent evacuation. The outer surface is usually rough and blocky (cauliflower aa); the inner surface is smoother but usually grooved, striated and marked with

flow lines, and the upper edge is sometimes crenulated. Typically levees lean inward and occasionally opposing levees arch over to join, forming a tube-in-tube. If there is a space (gutter) between it and the wall, it is a levee. Levees may be found at considerable distance above the floor. Gradational to tube-in-tube. Aka: arched ledge, coffin, cornice, crust, free-standing wall, gutter rim, kerb, lateral ridge, pull-off curb, rail, railroad track, sheared-out curb, sheared wall, spatter bench.

LINING. A layer of hardened lava left against the interior surface of a lava tube by intermittent flow. Linings may be fused to the host surface, mechanically locked in place by conformity or intermittently separated by air, clinkers, or zones of shear. Lining thickness is widely variable, ranging from millimeters to meters, and not necessarily uniform or complete. Lining is a primary feature: collapse, for example, may be primary or secondary. Curbs, benches, scrolls, and terraces are linings. Cf: crust. See also: lining plug, lining shut. Aka: accretionary layer, accretionary lining of lava plaster, ceiling lining, cemented, chilled margin, concentric shelling, crust, detachment laminae, dripstone, floor lining, laminae, laminations of the wall, lateral coating, lateral crust, lava coating, lavacicle plaster, lava lining, lava plaster, onion skin layer, peeled off wall lining, peeling accretionary wall, peeling wall, peeling wall of lava plaster, plaster, plastered, selvage, sheet of glassy lava, shell, skin, skin of basalt, tube wall lining, veneer, wall coating, wall lining.

LINING PLUG. An obstruction formed of successive linings that completely blocks a lava tube. Aka: plug, solid basalt of concentric rings, successive tube-in-tube, tube-in-tube.

LINING RUPTURE. Local detachment of a lining, usually limited to the near-tube strata. A recess formerly occupied by a patch of lining blown away by the pressure of exsolving gas, so weakened by vesiculation and/or remelt as to no longer withstand gravity, or exfoliated by differential shrinkage (spalled). Aka: blowout, blowout pocket, broken gas bubble, bubble, burst blister, burst bubble, gas blowout, peeling dripstone, peel-off, peel-off of dripstone plaster, peel-off of thin lava plaster, pull-down patches, pulled-out, pulled-out bubble, pull-off, pull-off patch, pull-out, pull-out patch, ruptured blister, ruptured bubble, ruptured lining, ruptured wall lining, sag.

LINING SHUT. Massive, opposing accumulations of linings on the walls of a lava tube which have joined to separate the tube horizontally. See also: lower level roof. Aka: initial roof stratum, partition, selvage.

LOWER LEVEL ROOF. A partition dividing a lava tube horizontally into multiple levels. Some incipient forms, often heavily modified by subsequent flow, are crusts, shelves, lining shuts, and tube-in-tubes. See also: bridge. Aka: balcony, cave-in-cave, ceiling, crust, double deck, false ceiling, false floor, false roof, horizontal division, internal balcony, internal roof, lava floor, lining partition, lower balcony, lower tube ceiling, multiple subsidiary roof level, new roof, overhang, partition, roof bench, roofing-over partition, roofing partition, roof of the lower level, secondary crust, secondary roof, septum, subsidiary roof level, successive floor, tube-in-tube, upper balcony, upper deck, upper floor.

MAIN TUBE. (a) A lava tube which supplies lava to all other downstream tubes and branches. (b) The largest of branch tubes. Note that a main tube is not necessarily a master tube. Aka: main cave, main distributary channel, main feeder tube, main lava feeder channel, main passage, major artery, major feeder tube, parent lava tube, trunk passage.

MAP LENGTH. The length of a cave derived using its vertical projection onto a horizontal surface. Cf: traverse length. Aka: projected length.

MASTER TUBE. A dominant lava tube in a lava tube system. A master tube typically occupies the axis of a low, broad ridge built by subordinate tubes and overflow from the master tube itself, and is readily identified if the system is studied, e.g. topographic maps nearly always reveal a tell-tale series of collapse trenches. Locally, individual lava tube caves may be identified as segments of a master tube by certain characteristic features: size (relatively large, voluminous), vertically elongate cross section and multilevel development, modifications reflecting sustained activity (large benches, shelves, and multiple linings), indications of erosion (down-cutting by the lava stream into pre-flow strata), and presence of subordinate tubes and overflow complexity at various levels. (Un-segmented, inactive master tubes probably do not exist; none have been described.) Aka: apical ridge, axial feeder tube, axial tube, axial tube system, central drainage channel, central supply tunnel, central tube, central tunnel,

dike-tube system, feeder conduit, feeder tube, feeding channel, large feeder tube, main axial feeder tube, main channel, main conduit, main feeder tube, main internal channel, main tube, main tube line, main tube system, major distributary, major drainage tube, major lava tube, parent lava tube, primary lava conduit, primary lava tube, primary passage, primary supply channel, primary tube, principal feeder, principal lava tube, rift, throughway tube, trunk channel, tube line.

MELT-OUT POCKET. A recess in the ceiling or wall seemingly created by remelting, usually found in clusters, sometimes in a perplexing association with fractures. Width and depth range widely, from a few centimeters to a meter or more. Related to lava tube boxwork. See also: remelt.

MICROGOUR. (a) A tiny rimstone dam (centimeter scale). (b) A small rimstone-like, or terrace-like deposit in lava tubes. They typically occur in stair step clusters on moderately sloping to vertical surfaces. Some are clearly compacted clastics; others appear to be mineral depositions. Though more common in lava tubes than rimstone dams, they are no better understood. Aka: gour, lava speleothem, lava wall gour, melt cup, rippled clastic flowstone.

MULTILEVEL TUBE. A lava tube having two or more levels, each longer than wide, separated by a lower level roof. Aka: compound tube, dike-tube, double decked, double tube, multiple levels, multistoried, multiple tube, primary tube, stacked, stacked drainage conduits, stacked passages, superimposed tube, tiered, two-storied, vertically stacked.

OPEN VERTICAL CONDUIT. An abandoned, essentially vertical passage through which lava rose to the surface. The mouth is usually, though not necessarily, at the top of some sort of vent structure such as a hornito, spatter cone, or spatter ridge. Aka: influx, influx tube, lava retreat, open vertical vent, spatter cone pit, vent, vent cave.

OVERFLOW CHAMBER. A cupola at the site of a lava tube overflow. Aka: distribution pool, former skylight [*sic*], overflow dome, rise chamber, roofed-over skylight [*sic*], upper balcony.

PAHOEHOE. A Hawaiian term for basaltic lava flows typified by a smooth, billowy, or ropy exterior and internally by lava tubes and nearly spherical vesicles. Pronounced PA-hoey-hoey. Literally "smooth" in Hawaiian. Cf: aa, cauli-

- flower aa. Following are descriptions of various types of pahoehoe surfaces, as defined in Gary (1972).
- Corded Pahoehoe.** The typical kind of pahoehoe, having a surface resembling coils of rope. Syn: ropy pahoehoe.
- Elephant Hide Pahoehoe.** A type of pahoehoe having a wrinkled and draped surface.
- Entrail[s] Pahoehoe.** A type of pahoehoe that has a surface resembling an intertwined mass of entrails, formed on steep slopes as dribbles around and through cracks in the flow crust.
- Filamented Pahoehoe.** A type of pahoehoe, the surface of which displays thread-like strands formed by escaping gas bubbles, and that are recumbent and aligned with the direction of flow. It is a common type and often found superimposed on other forms.
- Shark Skin Pahoehoe.** A type of pahoehoe, the surface of which displays innumerable tiny spicules or spines produced by escaping gas bubbles.
- Shelly Pahoehoe.** A thin-shelled, glassy type of pahoehoe, the surface of which contains open tubes and blisters; its crust is 1 to 30 centimeters thick. Shelly pahoehoe is characteristic of near-vent regions where devolatilization can occur rapidly to form empty blisters.
- Slab.** A type of pahoehoe, the surface of which consists of a jumbled arrangement of plates or slabs of flow crust, presumably so arranged due to the draining away of the bubbles, and that are recumbent and aligned with the direction of flow. It is a common type and is often found superimposed on other forms.
- Spiny.** A type of lava which, on a broad scale, has the smooth, gently undulating billows and ropes of pahoehoe, but on a millimeter scale resembles aa, having a spiny and granulated surface.
- PALEOSOL.** A buried soil, weathering profile, or soil horizon developed during the geologic past. When exposed by lining collapse, such layers provide an opportunity to study the relation of the lava tube and its host flow to the pre-flow topography. Aka: fossil soil horizon, interbed, paratubal earth, pre-flow soil, pre-lava soil [*sic*], soil horizon.
- PERENNIAL CAVE ICE.** Cave ice that persists, year around, for a period of years, sometimes receding or accumulating a little each year in response to climatic trends. Perennial cave ice is usually recumbent, against the wall or floor, rarely pendant, more or less clouded, is smoothly contoured as a result of melting or sublimation, and usually displays a few prominent fractures. It is often layered, reflecting seasonal accumulation as well as impurities introduced during melting and refreezing, and crystallized due to refreezing or fracturing. Cf: seasonal ice. Aka: fossil ice, permanent ice, perpetual ice, prismatic ice, year-around ice.
- PERCHED TUBE.** A distributary or tributary tube connecting some distance above the floor of a main tube, left hanging above subsequent flows. Cf: cut-off branch. Aka: hanging tube, higher tube complex, ledge, overflow cave, subordinate tube, tributary tube, upper tube remnant.
- PILLAR.** A body of rock which divides a cave for a short distance. How big can a pillar be? The definition suggested in Chabert and Watson (1981) seems reasonable: it is a pillar if its largest dimension is less than the combined width of the two passages it separates. Cf: column. Aka: column, island, mitertite, rock partition. (Though seemingly solid, most pillars in lava tubes are built around pieces or accumulations of breakdown.)
- PIPE STEM STALACTITE.** A partially deflated tubular lava stalactite having an oval or pinched transverse cross section, similar to the stem of a tobacco pipe.
- PIT CRATER.** A massive sink created by withdrawal of a large mass of lava. Not necessarily related to a lava tube.
- PLUNGE POOL.** A pool of lava at the base of a lava fall. Aka: lava fall pit.
- PRESSURE PLATEAU.** An uplifted area of a ponded lava flow, the uplift of which is due to injection of lava into a still-hot interior. Flows initially less than one meter thick which inflated to ten meters and more, have been described in Hawaii. Pressure plateaus are characteristic of tube-fed pahoehoe flows, created when the volume of lava delivered through a lava tube system exceeds the capacity of the flow front to expand.
- PRESSURE RIDGE.** An elongate buckling and uplift of the crust of a lava flow resulting from differential movement between the crust and underlying lava, that results in a ridge which is commonly cracked open at the top throughout its length, the cracks narrowing downward. An elongate tumulus. Cf: block rampart. Aka: fold, lava ridge, schollendom.

PRIMARY FEATURE. Conditions or features of a lava tube existing prior to cessation of lava flow and final cooling. (Note that collapse is as likely to be primary as secondary.) Cf: secondary. Aka: features of origin, intact, lava (as in "post-lava,"), original, pre-lava [*sic*], primary lava structures, synchronous, synflow, syngenetic.

PROFILE. An outline of a cave, along an arbitrary line, projected horizontally onto a vertical plane. Usually such a profile is a longitudinal section along the survey traverse, but in any event should be specified. Cf: cross section. Aka: cross section, longitudinal cross section, longitudinal section.

RAFTED BREAKDOWN. Single pieces or accumulations of solidified lava (usually pieces of breakdown) floated or entrained in a lava stream. Although solid basalt is slightly denser than the liquid, much breakdown floats because it contains vesicles. Cf: island. Aka: breakdown raft, lava-carried breakdown pile, raft, rafted, rafted blocks, synflow breakdown blocks.

RAISED-RIM CRATER. A surface depression created by collapse of a tumulus around which remnants of the tumulus remain as a raised rim or wall. Syn: block rampart. Aka: collapse blister, collapsed surface dome, collapsed tumulus, non-explosive craters with high outward-topped rims.

RE-ENTRANT TUBE. A lava tube which, having branched from a main tube or some other point in a lava tube system, rejoins downstream. Aka: bypass, cut-around, loop passage, loop tube, meander loop, ox-bow, side passage.

REMELT. Re-mobilization of solidified or partially solidified lava by re-heating. Remelted lava is probably not totally representative of the original melt. Some researchers insist that radiant heat and convection alone won't remelt solidified lava—that remelt is evidence of combustion. Remelt may be implicated in formation of boxwork-like features which are separated by projections of fractures Cf: lava tube boxwork. Aka: refluxed, refusion.

RESIDUAL DEPRESSION. A pit-like depression characteristic of extremities of tube-fed pahoehoe lava flows, resulting from inflation of a lava flow surrounding a chilled area. Easily mistaken for a collapse sink.

RESIDUAL OPENING. A primary opening into a lava tube. Three common kinds of residual openings are hornitos, drainbacks, and un-

roofed sections of contiguous lava channel. See also: entrance, skylight. Aka: skylight.

RIB. A vertical, or near-vertical, drapery-like ribbon of lava flowstone that projects from overhanging inclined surfaces. The form is gradational from a lava stalactite to lava flowstone. Size is influenced primarily by the fluidity (and drip size) of the molten constituents and steepness of the host surface. Thickness ranges from 0.5 to 1.5 centimeters and up, horizontal width averages 2.5 centimeters, but length (measured parallel to the host surface) ranges widely, from the discernable up to several meters on favorable host surfaces. Aka: dribble ridge, flow ridge, lavacicles that bend and flow into normal lava dripstone, lava drip ridge, lava rib, lava ribbon, lava trickle, long dripstone lavacicle, projecting rib, ribbed lava, ribbed wall, ribbon-like roof pendant, ribbon of lava, rib-like flow ridge, rib wheel, ridge, rivulet, run, thin parallel ridge, thin projecting rib, thin raised line, wall flute.

RIFT TUBE. A lava tube formed in lava flowing inside and through a rift. Aka: dike-tube, fissure tube, hollow dike, rheogenetic fissure cave, rift cave.

RIMSTONE DAM. A relatively thin, dam-like deposit with a level top surrounding a pool of water, common in solution caves. Rarely, small examples ranging in length from centimeters to decimeters, occur in lava tubes where water is abundant. The latter are deposited in the manner of speleothems, others are clearly clastic in origin, but no detailed studies are known. Cf: gour. Aka: gour.

ROOF. The basalt strata overlying a lava tube, usually including the initial roof crust. See also: bridge, lower level roof. Aka: bridge, overburden.

ROOTLESS VENT. A source of lava that is not directly associated with a true vent or magma source, commonly an upwelling or overflow from a lava tube. See also: cupola, hornito, open vertical conduit, rise chamber.

ROPY LAVA. A lava flow with a corrugated surface resembling coils of rope. The corrugations are a broad scale distortion of various smoother surfaces, resulting from differential internal and external movement, e.g. cauliflower aa floors modified with "ropes" over a foot thick are not uncommon. The ropes are typically closely spaced, curved, and convex in the direction of underlying flow. Inside lava tubes and

- channels, rope thickness ranges widely, from less than an inch up to a foot or more, but on the surface may be far thicker. Cf: festoon. Aka: clinkery pahoehoe ripple, corded pahoehoe, curved corrugations, drag fold, festooned ropy pahoehoe, flow ripple, flow wrinkle, frozen ripple, pahoehoe rope, pulled pattern, ripple, rippled lava, ripple marks, ropy pahoehoe, wrinkle.
- RUNNER.** Small, recumbent, roughly cylindrical, sausage-like rivulets of lava flowstone with a glazed skin, that are not fused with the surface on which they rest. Much like tubular lava stalactites, but usually of larger diameter. Cf: lava toe. Aka: lava dribble, lava trickle, rivulet, streamlet, worm, worm's nest.
- SAND CASTLE.** A column of clay, mud, sand, or similar clastic sediment left by preferential erosion of the surrounding material by dripping or flowing water. Aka: badlands, fairy castle, mud turret, sand castle stalagmite, sand stalagmite, silt pillar, tent rock. (The column is preserved either by a cap-stone, a relatively large piece of detritus which deflects the water drops, or a "dry" area in the pattern of dripping water.)
- SCROLL.** A unique form of lining failure that occurs when still-plastic lining rolls off the wall, creating a cylinder shaped like, but much larger than, a loosely or partially rolled parchment. Scrolls range in diameter from inches to several feet. Aka: "A" type lava ledge, banking up and curling back, bench of . . . curled lava crust, broken and curled lava crust, broken and curled slabs, cigar-like cylinder, curled detachment laminae, curl-up, curly bench, jelly roll (curl), laminae, lava roll, lava rope, lining scroll, low bench of curled-down lava crust, peeled lining, peeled off wall lining, peeling accretionary wall, peeling wall, peeling wall of lava plaster, peel-off, peel-off of dripstone plaster, peel-off of thin lava plaster, peel-off shell, plastic deformation, pull-off curb, pull-out, roll, shells of peeling lava plaster, snake-shaped pipe, wall lining, wall scroll.
- SEASONAL CAVE ICE.** Cave ice that forms in winter or early spring, and is gone by late fall. Seasonal ice may occur anywhere in a cave and in nearly all the well known speleothemic forms—crystals, flowstone, helictites, draperies, stalactites, and so on. Seasonal cave ice is usually optically clear unless formed of runoff water. Cf: perennial ice. See also: speleothem. Aka: annual ice speleothem, ephemeral ice, transient ice.
- SECONDARY FEATURE.** Modifications or additions to a lava tube following cessation of the host lava flow and cooling. (Note that collapse is as likely to be primary as secondary.) Cf: primary feature. See also: collapse, secondary. Aka: intact, intruding lava dripstone, post-activity (collapse), post flow, post-lava, post-volcanic, post-volcanic (roof) collapse, reactivated system, secondary basaltic ornamentation, secondary collapse, secondary flow features. (For example, collapse, invasion by subsequent lava flow, detrital deposits, mineral deposits (speleothems), and erosional modifications are secondary features.)
- SEMITRENCH.** A lava tube formed by roofing over of a lava channel having walls that are built up as levees.
- SHARK TOOTH STALACTITE.** A blade-like lava stalactite. Usually about as wide as long, they taper radically to a small drip-sized, spherical tip seldom exceeding one centimeter. in diameter. On horizontal ceilings they occur as individuals, are roughly symmetrical about a vertical axis, and resemble a large rose thorn. It is not unusual for two to be joined along a vertical centerline, forming a three-cornered base. If the host surface is inclined, the individual stalactites are skewed downhill en masse until ultimately, on near-vertical surfaces, they merge, forming drapery-like ribbons standing out from the wall. Shark tooth stalactites are typically smooth and thinly glazed externally, uniformly vesiculated internally, and do not reflect the restraint of a tough outer skin to the degree that tubular lava stalactites and runners do. Occasionally they are distorted en masse, parallel to the cave passage, as if deflected by gas or lava flow. Aka: drip pendant, lavacicle, homogenous stalactite, lava pendant, rose thorn pendant, shark's tooth projection, shark's teeth lava pendants, shark's teeth, tapered stalactite, triangular lava drip, wide triangular blade. (See rib).
- SHELF.** An elongate, overhanging crust, remnant of a crust, or accumulation of linings attached to a lava tube wall. Shelves are gradational to and from lower level roofs and, as a rule, follow the lava tube's grade. Cf: strandline. Aka: arched ledge, balcony, boundary ledge, bulge, cornice, cornice-like formation, cornice-like shelf, crust, curb, curb lining, flow crest line, former lava level, hanging ledge, high lava mark, high stand, lateral ledge, lateral ridge,

- lava mark, ledge, overhanging flange, overhanging ledge, relict lava strandline, solidified edge, temporary surface level, tide mark, trench shelf, true balcony, wall ridge.
- SINK.** A general term for a depression in the land surface. Syn: sinkhole. See also: collapsed lava pond, collapse sink, residual depression. Cf: trench.
- SKYLIGHT.** (a) An opening in the roof of a cave that admits daylight. (b) An opening in the roof of a lava tube that admits daylight and is not considered to segment the lava tube. ("Skylight" is used interchangeably with "entrance," especially if it's the only or customary way in.) See also: entrance, drainback. Aka: breakdown, breakdown skylight, ceiling collapse, collapse hole, collapse pit, collapse to surface, residual skylight, skylight entrance, well, window.
- SLIP BANK.** The apron on the convex side of a lava tube meander bend where occasionally cooler, slower moving lava accumulates. Cf: cutbank.
- SLUMP BLOCK.** A large lateral block of basalt that slumps, more or less as a unit, into a collapse trench as a result of being undermined by collapse of a lava tube. They range in size from one or two meters to tens of meters. Aka: lateral slump block, slumped-off column.
- SODA STRAW STALACTITE.** (Or simply "soda straw.") A predominantly straight tubular stalactite. Aka: lava soda straw stalactite, lava straw, lavatite, rod stalactite, soda straw, soda-straw cicle, soda straw-diameter stalactite, straw stalactite, straw tube, thin spindly lavacicle, tubular lavacicle, tubular soda straw-like stalactite.
- SLUMPED LINING.** Lining deformed by gravitational slumping and buckling while still plastic, literally sliding down the wall. See also: festoon. Aka: deformed glaze, drag fold, drapery, drapery of lava dripstone, plastic deformation, slump, slumped glaze, slump ripple, wall drapery, wrinkle, wrinkled flow ridges.
- SPATTER.** Small fragments or clots of ejected lava, commonly agglutinated upon coming to rest.
- SPATTER CONE.** A steep-sided cone of agglutinated spatter built up on a fissure or vent. Cf: hornito, open vertical conduit. Aka: agglutinate cone, blow hole, blowout, chimney, pneumatogenetic explosive cave, spatter vent, vulcanello, vulcancito.
- SPATTER RAMPART.** A low wall of agglutinated spatter produced by fountains of very liquid lava erupted from fissures. Cf: spatter cone.
- SPATTER STALACTITE.** A lumpy, irregular, highly vesiculated, concentric-layered lava stalactite accumulated from spatter. Common inside spatter cones. Cf: dip-layered stalactite. Aka: granular concentric stalactite, thick bodied lava stalactite.
- SPLASH CONCENTRIC.** Concentric ripples formed in a partially-hardened floor by a piece of falling breakdown. Occasionally found some distance down-tube from the site of the rockfall. Aka: concentric.
- SPELEOTHEM.** A mineral deposit formed in a cave. Coined in 1952 from the Greek "speleion" (cave) + "thema" (deposit). A generally accepted, but frustrating term that differentiates an icicle formed in a cave from one formed under a highway bridge — and rests on the insecure definition of a cave. The most abundant mineral deposited in lava caves is ice. Next in order of abundance are silicates, sulphates, and carbonates — the latter usually co-deposited with silicates. Ice, mirabilite, and opal are more abundant in lava caves than solution caves. Common forms of minerals deposited in lava tubes are stalactites, films, coatings, coralloids, and crusts — less common are anthodites, crystals, flowstone, stalagmites, helictites, and heligmites. Aka: caliche, cave formation, cave ice, cave stalactite, coating, decoration, formation, glaze, ice candle, ice formation, lava blister, lava lace, ornamentation, post-volcanic speleothem, secondary, secondary deposit, secondary chemical deposit, secondary mineral, secondary mineralization, secondary speleothem, secondary stalactite.
- SQUEEZE-UP.** An extrusion of lava emanating from a fracture or other opening in the solidified surface of a lava flow, e.g. from between the wall and floor crust in a lava tube. It may be bulbous or elongate, and may exhibit grooves. See also: grooved lava. Aka: lava boil, overflow squeeze-up, tumulus mound.
- STALACTITE.** A generally elongate, pointed or tapering, gravity-controlled, object of deposition that hangs from a ceiling or overhanging surface. A stalactite is not necessarily a speleothem. They form in all types of caves, as well as mines, vugs, veins, tunnels, hot springs, under bridges, and so forth. Coined in 1655 to describe many examples, some from caves,

which “. . . belong to the Icicle class. . .” (Worm, 1655). Stalactites composed of amberat, lava, minerals, mud, peat, pitch, sand, and sinter have been described. Virtually any material which is soluble, or can be carried as a colloid or in suspension, or which may melt under given conditions, can form a stalactite. Cf: helictite. See also: lava stalactite. Aka: cave stalactite, depositional stalactite.

STOPING. Upward migration of a chamber or passage due to ceiling collapse. There may be a corresponding accumulation of breakdown. See also: collapse. Aka: breakdown dome.

STRANDLINE. The congealed margin of a quiescent body of lava. Unlike a shelf that follows the hydrostatic grade, a strandline is horizontal. Cf: flow line. Aka: bathtub ring, high flood mark, high lava mark, high stand, shoreline, solidified edge, stand line, thin mini-ledge, tide mark.

STRETCHED LAVA. A body of partially hardened lava stretched between points or zones of attachment which moved apart. Distinctive stretch marks result, which generally reflect (among other things) viscosity, vesicularity, and always direction of tension. Stretched lava is common between patches of slumped lining which separated and between wall and subsiding floor. If tensile strength is exceeded, stretched lava projections result (see below). Aka: pulled pahoehoe, pull marks.

STRETCHED LAVA PROJECTION. Projections resulting when stretched lava is pulled apart. The torn shapes range from thread-like strands with needle-sharp points to wide, curtain-like, sharp-edged sheets. They are typically elongate and symmetrical in transverse section, with varying degrees of taper from base to point. Unlike stalactites, with which they are often confused, they need not be vertically oriented (often are not), and have sharp points or edges. Aka: blade stalactite, drooping “hands,” needle-like lava stalactite, pulled stalactite, ribbon lavacicle, ribbon stalactite, shark’s-tooth projection, shark tooth projection, shark teeth-slickenside, sharp lava stalactite, sharp pointed lavatite blade, stretched stalactite, tear-tite, treacly lava stalactite.

SURFACE TUBE. The hardened outer jacket of an elongate lava toe, or lobe, that drained. Typically, surface tubes have a uniform wall thickness and semi-circular cross section, flat side down against the surface on which they formed. Branching is common and broadly dendritic

networks are not unusual. Widths range from a decimeter to several meters. Length depends primarily on an uninterrupted supply of lava and ranges widely. Surface tubes are far more numerous than is generally realized because most are subsequently buried. See also: lava tube. Aka: miniature lava brooklet, miniature tube, minor lava tube, surface lava tube, tertiary lava tube.

TEAT STALACTITE. A lava stalactite shaped like an inverted cone, having a generally circular transverse cross section and a drip-sized tip. Aka: conical ceiling stalactite, cow teat stalactite.

TERRACE. A wide bench.

TONGUE. An elongate, raised flow of lava. Tongues in lava tubes usually have a cauliflower aa surface. Aka: flow tongue, lava floor tongue, lava ridge, lava toe, narrow lobe.

TRAVERSE LENGTH. The length of the traverse on which a cave map is based. Roughly, the total distance one would travel if visiting all the cave’s passages. Cf: map length. Aka: continuous linear development, linear development, slope length, sport length, total surveyed traverse, true slope length.

TRENCH. (a) A collapse trench. (b) An empty lava channel. Aka: lava trench. It can be difficult to discern the difference if relatively old and eroded.

TRIBUTARY TUBE. A lava tube that feeds into another. Aka: coalescent tube, confluent branch, confluent tube, convergent branch, feeder tube, ingressive branch, side tube. (True tributaries are rare; tubes which appear to be tributaries are usually re-entrant tubes.)

TRUE TRENCH TUBE. A lava tube formed by roofing over of a lava channel constituting a single flow unit.

TUBE-FED PAHOEHOE (lava flow). Tube-fed pahoehoe lava flows are characterized internally by lava tube systems and layered structure. Externally they are broad and thin, with a broadly dendritic plan, feathering out from low broad ridges overlying master lava tubes. Large collapses sinks and trenches, chains of hornitos, skylights, and small rootless lava flows (see rootless vent) are characteristic of the upper and mid parts of the flow. Various expressions of inflation, like tumuli, pressure plateaus, and residual depressions on decimeter to kilometer scales are numerous at the extremities. Tube fed-lava reaches sites so far

removed from the vent only because lava tubes so efficiently carry lava with little loss of heat.

TUBE-IN-TUBE. A smaller tube resulting from medial closure of inward leaning levees, on the floor of a lava tube, and usually consisting of the last flow through the tube. The outer surface is typically cauliflower aa and the inner surface may be grooved. Complete tube-in-tubes are seldom long, but lengthy sequences of levees, roofed sections, and collapsed sections are common. Aka: coffin, encased tube, hollow tongue, internally developed tube, mummy's case, secondary lava tube, tube lining.

TUBULAR LAVA STALACTITE. A tubular stalactite composed of lava. Most are slightly and uniformly tapered. Their diameter, averages about 0.7 centimeter, and often decreases slightly toward the tip, but extremes from 0.4 to 1.0 centimeter have been noted. Lengths range from the perceptible to a meter and more. The tip may be hemispherical, or open for a considerable distance, but the interior is usually an entrainment of elongated vesicles and septa. The outer surface may be macrocrystalline and partially or completely marked with shallow annular grooves thought to be growth increments. They often serve as conduits for considerable quantities of fluid lava. Stalagmites of 100 times the volume of corresponding tubular stalactites are not uncommon. Frequently occurring in combination with lava helictites, they may be crooked, straight, branching, botryoidal, deflected, twisted, even deflated, or combinations of the above. See: pipe stem stalactite, soda straw stalactite. Cf: runner. Aka: bracken-like stalactite, conduit form, conduit speleothem, hollow dripstone tublet [*sic*], icicle-like pendant, icicle-like stalactite, icicle-like projection, irregular tubular lavacicle, lavacicle, lava formation, lava pipestem, lava straw, lavatite, rod stalactite, roof cicle, small stalactite, soda straw, soda-straw cicle, soda straw-diameter stalactite, straw stalactite, thin spindly lavacicle, tubular lavacicle, tubular soda straw stalactite, tubular soda straw-like stalactite, tubular stalactite, worm, worm stalactite.

TUBULAR STALACTITE. A hollow stalactite of nearly uniform diameter deposited from a hanging drop of liquid. Both mineral and non-mineral tubular stalactites have been described. See also: tubular lava stalactite.

TUMULUS. A doming or raising of the surface of a lava flow, typically elliptical in plan and lenticular in section, caused by hydrostatic pressure of underlying fluid lava (e.g. from a lava tube), or horizontal thrusting and buckling due to differential movement between the crust and underlying lava. They are a characteristic of the distal part of a well developed lava tube system. Tumuli are not usually hollow like blisters, although they may be as a result of lava draining out after their formation. A tumulus may be residual, i.e. surrounded by collapse resulting from differential draining away of underlying fluid lava. Gradational to pressure ridge. Cf: lava blister. Aka: agglutinate pile, hollow tumulus, lava bubble, lava dome, pressure dome, schollendom, stony rise, surface dome, trench.

UNITARY TUBE. An essentially unbranched lava tube. (Strictly speaking, only the smallest, most rudimentary lava tubes remain unbranched if flow is sustained, but segments of major tubes and systems without known branches of relative consequence are common.) Aka: simple (lava tube), unbranched, unitary conduit.

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