SEISMIC DATA FROM THE MAIN CRATER OF THE PROPOSED SIRENTE METEORITE CRATER FIELD (CENTRAL ITALY). G. G. ORI[1], A. P. ROSSI[2], G. KOMATSU[1], J.ORMO[3], M. RAINONE[4], P. SIGNANINI[4], P. TORRESE[4], P. SAMMARTINO[4], R. MADONNA[4], A. BALIVA[1] and G. DI ACHILLE[1], [1]International Research School of Planetary Sciences, Università d'Annunzio. Viale Pindaro 42, 65127 Pescara, Italy (ggori@irsps.unich.it) [2]Present address: ESA, ESTEC Research and Scientific Support Department, PO BOX 299 Keplerlaan 1, 2200 AG Noordwijk, The Netherlands, [3]Centro de Astrobiología Instituto Nacional de Tecnica Aeroespacial. Ctra de Torrejón a Ajalvir, km 4, 28850 Torrejón de Ardoz, Madrid, Spain [4]Dipartimento di Scienze della Terra, Università d'Annunzio, Via dei Vestini 30, 66013 Chieti Scalo, Italy.

Introduction: We present the first seismic study on the internal structure of the main crater in the proposed Sirente crater field. A deep bowl-shaped geometry contrasts with the surrounding chaotic to mounded seismic reflections that lie beneath the surficial raised rim. The features interpreted from our seismic survey are consistent with the impact hypothesis but do not exclude other interpretations. The Sirente crater field is made up of a main crater (about 120 meters in diameter) and a number of smaller craters less than 10 metres in diameter. The crater field is located in a mountain plain at the foot of the Sirente Massif (in excess of 2500 metres in elevation). The main purported crater contains, at present, a shallow water lake. The meteoritic origin of this structure has been proposed by Ormo [1, 2]. Other interpretations have been suggested and the most interesting is that anthropogenic one [2, 3]. The ages of the purported crater is around 400 AD according to Ormo [1, 2].

Figure 1. A. View of the main crater with a prominent rim. B. The seismic crew installing geophones on the ice-covered lake that occupies the Sirente main crater.

The crater field is located in swamp to lacustrine deposits that accumulated in the half graben of the plain since the late Holocene. These deposits consist of mud with variable carbonate content. Organic-rich layers are present. Therefore, the target of the purported impact was a swamp or shallow-water lake with fine-grained (probably water-saturated) deposits.

Methods: During the winter 2004 the ice covering the lake inside the main crater allow the shooting of high-resolution seismic lines. The refraction seismic line 1 is 120 meters long; and was acquired using P waves. It traverses the main structure eccentrically with a N 80 W direction (Figure 1).

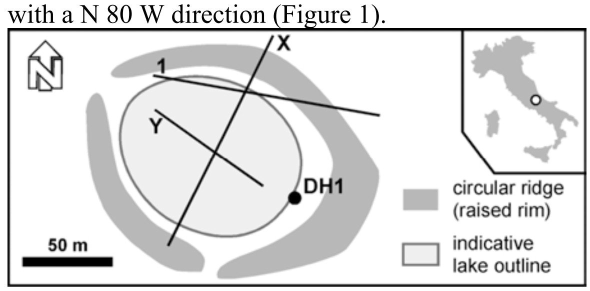

Figure 2. Locations of the seismic lines (X and Y) and of the refraction line (1). DH1 is the location of the core described by Ormo [1]

The two high-resolution reflection seismic lines were acquired across the structure using P waves. Seismic reflection profile X is 113 m long and intersects the main structure rim to rim. The shorter reflection seismic profile Y is roughly transversal to profile X. It is 61 m long. The receiving system consisted of an array of three 10 Hz vertical geophones for each channel (12 channels). The distance between each geophone and each seismic pulse generation point was 2 m, with a 6 m offset.

Stratigraphy and seismic facies: The two seismic lines show a number of facies that comprise a single structure made of a (i) high-amplitude package and (ii) surrounding chaotic facies. The high amplitude package consists of 4 different seismic facies recognizable by the amplitude, frequency and geometry of their reflectors. Facies 1 consists of the uppermost continuous horizontal and parallel reflectors that represent the sediments of the lake floor.

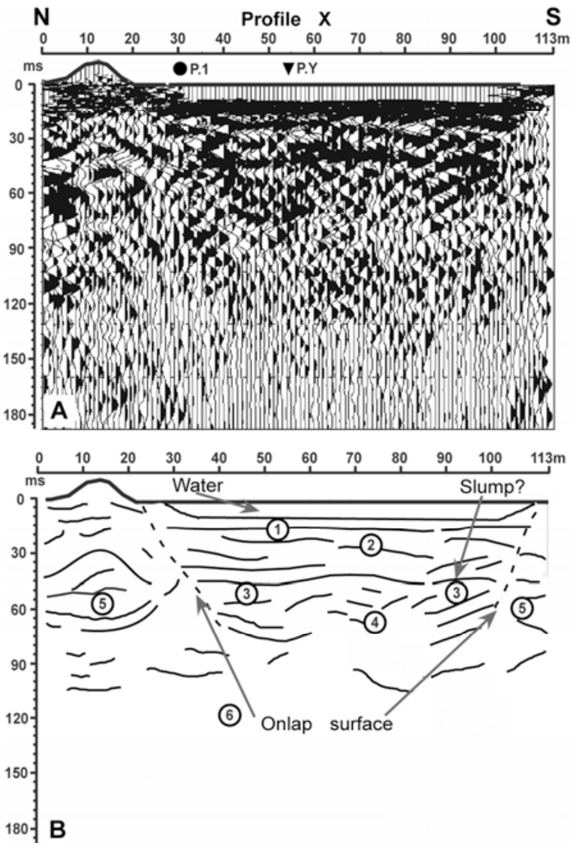

Figure 3. Seismic line X (see location in Figure 2).

Facies 2 underlies facies 1 and shows more discontinuous parallel to slightly curved reflectors. Facies 3 is the deepest facies and consists of very discontinuous reflectors, at places, inclined toward the center of the package. Facies 4 is observable only on line X and consists of the very low-amplitude reflectors forming a zone within the high-amplitude package and just missed line Y. This seismic facies association is entirely surrounded by the chaotic discontinuous reflectors of facies 5 against which they form onlap termini. From the stratal pattern and geometrical relationships the high-amplitude package (facies 1 to 4) seems to be the infilling of a bowl-shaped basin surrounded by facies 5. The reflectors of these facies pass downward into poorly defined reflectors displaying low amplitude and variable frequencies (facies 6). These reflectors probably correspond to the high-velocity zone observable at the base of the refraction line 1 and interpreted as the limestone bedrock. The bowl-shaped structure seems to rest on top of this bedrock with an irregular boundary.

Discussion: The subsurface structure clearly matches surface morphology. The rim corresponds in the subsurface to facies 5 that distinctively displays convex–up reflectors suggestive of uplifted material, and the lacustrine basin corresponds to the package of facies 1 to 4 suggestive of basin infill. Facies 6 limits the structure at depth. Facies 3, characterized by convex and concave reflectors, could indicate slumps and slump scars: this facies is well exposed in the reflection lines, suggesting an important role of deformation and slumping in the formation of the bowl-shaped structure. Facies 4 possibly corresponds to disrupted material, with no clear discrete deformation features or internal layering. Above facies 3, the presence of facies 2 may represent tabular to lenticular bodies with low lateral continuity, which we interpret as possible mudflow deposits. Finally, facies 1 possibly corresponds to laterally continuous post-slumping lacustrine deposits. The circular ridge (or rim) on the surface corresponds to facies 5 at depth, while the shallow lake is associated with the bowl-shaped package consisting of facies 1 to 4. Moreover the entire bowl-shaped structure (facies 1-4) is clearly rootless and has depth in excess of 50 m. The seismic data support the meteorite impact interpretation, but do not exclude other hypotheses.

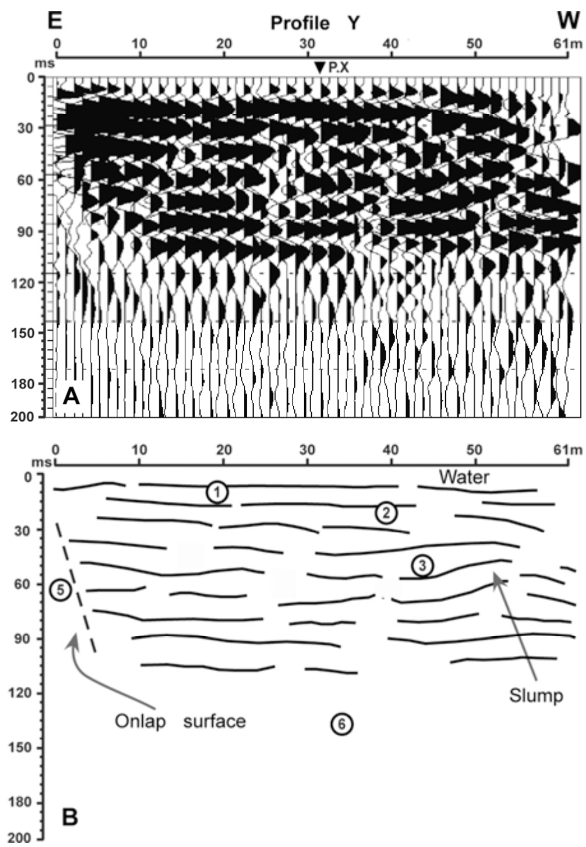

Figure 4. Seismic line Y (see location in Figure 2)

References: [1] Ormo J. et al. (2002) *Meteoritics & Planet. Sci., 37,* 1507 - 1522. [2] Ormo J. et al. (2006) *Meteoritics & Planet. Sci., 41,* 1331 - 1345. [3] Speranza et al. (2004) *Meteoritics & Planet. Sci., 39,* 635 - 649.