The Sirente craters (Italy): On the possible origin of geomagnetic anomalies (Ormö et al. 2007)

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Abstract. - Abundant finds of exploded ordnance in the Sirente crater field suggest that geomagnetic anomalies measured in connection with some of the craters may have a simple explanation. Without a consideration of these iron-metallic fragments and of possible unexploded ordnance, any conclusions with respect to the crater formation based on magnetometer surveys only, are questionable.

Introduction

The Sirente crater field in Italy consists of about 30 depressions with a main rimmed 120 m-diameter crater. The origin of the craters is disputed and has been ascribed to meteorite impact (Ormö 2002), to mud volcanic processes (Stoppa 2006) and to anthropogenic activities (Speranza et al. 2004). So far, no impact features like meteoritic material, geochemical signature or shock metamorphism have been identified (Ormö et al. 2006). According to Oril et al. (2007) seismic data from the main crater support the meteorite impact interpretation but do not exclude other hypotheses.

In a recent article printed in the *Meteoritics & Planetary Science* journal (editorial handling - John Spray), Ormö et al. (2007) are reporting on a magnetometer survey in the Sirente crater field. From a modeling of magnetic anomalies measured over some of the smaller depressions they reason uplifted crater rims and buried meteorites. Here, we report on a field trip to the Sirente crater area revealing that measured magnetic anomalies may at least partly be related with exploded and/or unexploded ordnance.

Field evidence

On April 12, 2004, one of the authors (W. M.) together with Christian Siegl visited the Sirente crater field (Fig. 1). The field trip was initiated after the discovery of the Holocene Chiemgau impact strewn field in Southeastern Germany (Rappenglück et al. 2004, Schüssler et al. 2005, CIRT 2006, and others) with the intention of comparing both locations.

Fig. 1. The Sirente crater field in Italy. Photo W. Mayer.

In the course of a close field inspection guided among others by the hope of finding meteorites, metallic fragments could actually be sampled in great quantities (Fig. 2), and a concentration was observed in the environs of the smaller depressions in the north and northeast of the main structure. Here, many iron-metallic fragments were found even at the floor of smaller craters. On extrapolation of the finds, several thousands of iron fragments or a mass of estimated one ton at least are expected to exist in the Sirente field.

Fig. 2. Exploded ordnance iron splinters from the Sirente crater field. Photo W. Mayer.

Rapidly, it became explicit that the sampled iron splinters, typically shown in Fig. 2, were fragments of exploded ordnance like bombs and grenades.

Discussion and conclusions

The find of abundant fragments of exploded ordnance has implications and poses some questions. In the first place and disregarding for the moment the dating of some craters to ~ 500 A.D. (Ormö et al. 2006), we pose the question whether some of the smaller craters (with diameters between 1.5 and 20 m and a maximum depth of about 2 m) could have originated from military operations implying bombing and, therefore, are simple explosion craters. On the other hand, in areas of exploded ordnance there is in general also unexploded ordnance to be encountered. It is well known that, e.g., in World War II roughly 10 - 20% of released bombs survived unexploded in the ground. In Italy, more than 1 million bombs were air-dropped by the Allied Forces, and at least 10 % did not explode (Furlanello & Merler 2001). In most cases they are leaving only small flat depressions to be possibly seen in aerial photographs. In the case of the Sirente ground of carbonate mud, the penetration of an unexploded bomb could perhaps have produced a somewhat larger depression although the hole of entry is in general much smaller (see, e.g., War Department 1943). The depth of penetration of blind shells has frequently been considered. For a 250 kg sized bomb, the depth has been found to be 5 m on average and 12 m maximum, and for a smaller, 50 kg sized bomb the respective numbers are 3.5 m and slightly less than 12 m (War Department 1943). In a soft muddy ground like in the Sirente area, a penetration depth at the upper limit can be expected.

Both exploded and unexploded ordnance are known to be related with magnetic anomalies, and magnetometer surveys by total-field and gradiometer soundings are basic in the detection of unexploded ordnance. A typical bomb magnetic anomaly is shown in Fig. 3., while Fig. 4 exhibits a magnetic map of a field full of exploded ordnance.

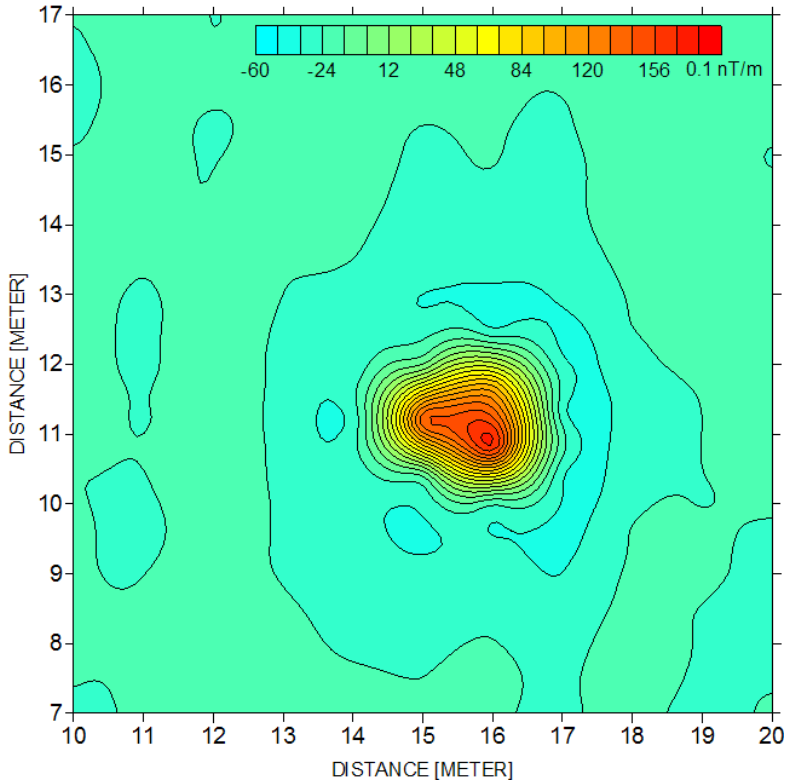

Fig. 3. Typical WW II blind shell geomagnetic anomaly. Vertical gradient of the geomagnetic vertical field intensity.

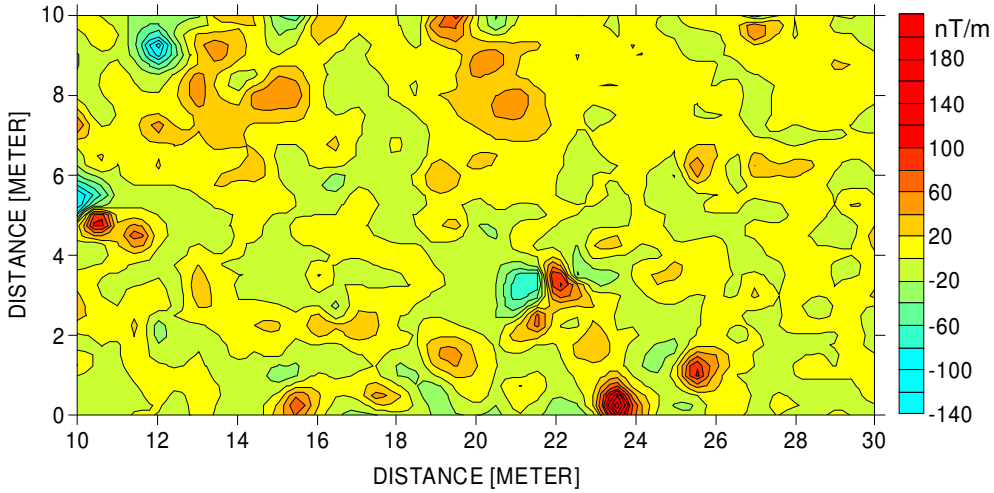

Fig. 4. Geomagnetic map of exploded-ordnance anomalies. Vertical gradient of the geomagnetic vertical field intensity.

Summarizing, the find of exploded ordnance in the Sirente area points to military activities in the past, and a historical inquiry could possibly provide some insight. As exploded ordnance is frequently accompanied by unexploded ordnance, it cannot be

excluded that some magnetic anomalies measured and modeled by Ormö et al. (2007) originate from deeply penetrated bombs. In this case and confusing bomb anomalies with supposed anomalies from meteorites, attempts to recover them (especially when a drilling into an object is to be executed [Ormö et al. 2007]) could be a dangerous endeavor.

This is one side of the coin. The other side concerns the subject of the article (Ormö et al. 2007) that is the discussion of the impact origin for the Sirente crater field and the alleged substantiation by the results of the geomagnetic survey.

To avoid any misunderstanding we explicitly state that we don't intend to knock the impact hypothesis on the head. To the contrary, an impact origin for at least the largest crater seems to be much plausible. We are also aware of the radiocarbon and TL dating (Ormö et al. 2006) probably excluding an origin from military operations for at least those structures. However, as long as the magnetic survey completely ignores the abundant exploded ordnance and the possibility of anthropogenic magnetic causative bodies in the ground, the article by Ormö et al. (2007) and the conclusions therein are without any value. This yet again demonstrates that a peer review doesn't prove a recipe for good science.

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