GEOPHYSICAL SIGNATURES OF THE ROTER KAMM IMPACT CRATER, NAMIBIA:

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SUMMARY: New gravity and magnetic data have been collected in- and outside of the Roter Kamm impact crater [1], as in previous studies [2,3] the traverses did not extend sufficiently beyond the rims, and, hence, the regional values were not adequately constrained. The gravity results of this study were similar to those of Fudali [2]; a negative, near-symmetrical anomaly was obtained over the crater center, which conforms to that expected for a sediment-filled, simple bowl-shaped crater. The magnetic results of this study, however, are different from those reported earlier [2,3], most probably due to the longer profiles of this study. A slight positive magnetic anomaly was obtained over the crater interior, and, as noted by [2,3], magnetic noise was observed in the vicinity of the rim. We also report on a first finding of suevitic breccia at Roter Kamm.

INTRODUCTION: Roter Kamm, a confirmed impact structure [1] located in the Namib Desert of Southern Namibia, is near-circular and has a diameter of ca. 2.3 km. Aeolian sands are pervasive both inside and outside of the crater; the only exposures of Precambrian granitic rocks are found high on the partially covered rim. Due to sparse outcrop, geophysical studies are particularly important to determine the geology of the crater. First geophysical studies were reported by Fudali [2] and included two gravity and one magnetic profile across the crater interior. The gravity data could be modelled to fit a simple, bowl-shaped crater of 700-800 m depth. Fudali's NS magnetic profile was completely featureless, except for appreciable noise in the vicinity of the rim. He suggested that this was caused by brecciation and block rotation in the crater rim. Results of two magnetic traverses, in SE-NW and NE-SW orientations, were reported by Reimold et al. [3]. These authors obtained similar results as Fudali [2], except for a higher noise level over the interior of the crater, which they attributed to possible magnetic concentrations and moisture differences in the sands of the crater fill.

GRAVITY RESULTS: Seventy-five gravity stations, at 60 m intervals, were located along a single north-south traverse (Fig. 1), extending ca. 1000 m beyond the crater rim. The topographic and gravity profiles are shown in Figs. 2a and 2b, respectively. After standard gravity data reductions (except for terrain corrections of <0.5 mgal), a centered, near-symmetrical anomaly of -8.8 mgal was obtained (Fig. 2b). The small positive perturbation on the outer southern rim (Fig. 2b) is probably due to compositional differences in the basement rocks, which have been noted to be very heterogeneous [1]. The low density sediments, filling the crater, are believed to be the primary contributor to the observed negative gravity anomaly over the crater interior.

MAGNETIC RESULTS: Magnetic data were collected at 30 m intervals along the same N-S traverse used for the gravity study (Fig. 1). The raw data were corrected for diurnal variations and the corrected profile is shown in Fig. 2c. The shape of this profile is somewhat different from those of Fudali [2] and Reimold et al. [3], which are generally featureless. The only similarity is the high noise level close to the rim. Our results show a slight (approx. 30 nT) positive magnetic anomaly over the crater center, which dies out abruptly with distance from the crater rim. It should be noted that the profiles of Fudali [2] and Reimold et al. [3] did not extend very far beyond the rim, which may be the reason why the change back to regional magnetic values was not observed.

FIRST REPORT OF SUEVITIC BRECCIA FROM THE ROTER KAMM CRATER: As the dunes covering parts of the crater have shifted significantly since the last visit a few years ago, some of us carried out a geological reconnaissance walk around the structure. The newly accessible basement outcrops basically confirmed the geological results of earlier studies [1]. However, in a several tens of meters wide patch on the eastern crater rim (Fig. 1, star), abundant, up to 15 cm diameter, chunks of a greenish-grey breccia with numerous macroscopically visible granitoid clasts were discovered. Microscopic examination revealed that most clasts are indeed granitoid-derived, with small components of mafic (gabbroic or granulitic) clasts existing as well. In addition, a variety of glassy or partially devitrified, often well-rounded, barbell- or amoeba-shaped, clasts are abundant. Shock metamorphosed basement clasts are rare, with only a few quartz clasts with 1 set of PDFs having been detected to date. This observation is consistent with the generally low shock degree of the autochthonous basement of this relatively small impact crater. However, there can be no doubt that this new breccia type from Roter Kamm is an equivalent of the suevite known from many other impact structures.

CONCLUSION: The negative gravity anomaly (-8.8 mgals) obtained is within the limits reported for other small impact craters, and the shape of the anomaly is compatible with the anatomy of a simple bowl-shaped impact crater. Although the dominant magnetic effect over impact craters is a magnetic low, the general character of magnetic anomalies associated with impact structures is variable, due to the variation in the magnetic properties of rocks [4]. In this case, the reason for the observed positive (+30 nT) magnetic anomaly is not obvious. It can be speculated whether it could be related to the formation of magnetic phases due to shock metamorphism (e.g., magnetite forming after amphibole and biotite), or may be due to the existence of a small magnetic (melt?) body (or lining at the crater floor) in the interior of the crater. However, before such speculation takes over, it should be considered that the normal variation of repeated measurements within a few meters of any given measurement station could be as high as 10 nT - seriously diminishing the absolute values constituting the slight anomaly. The increased noise recorded at the crater rim is most probably caused by brecciation and block rotation in the crater rim [2,3].

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Figure 1 Locality map of the Roter Kamm impact crater and position of the geophysical profiles. Star: suevite occurrence.

Figure 2 (a) Elevation profile; (b) gravity profile; and (c) magnetic profile across the crater.