ANISOTROPY OF MAGNETIC SUSCEPTIBILITY OF TARGET ROCKS AND IMPACTITES FROM DHALA IMPACT STRUCTURE, INDIA.

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Introduction: The Dhala Impact Structure in India (25º17'59.7″, 78º08'3.1″) is an eroded remnant of a complex, asteroid impact crater of Paleoproterozoic age with an estimated diameter of ~11 km [1]. The bedrock lithology includes calc-silicate rocks, ~2.5 Ga granitoids (TTG), giant quartz veins, and dolerites. This basement is overlain by post-impact sedimentary rocks of the Vindhyan Supergroup of 1.6 Ga age [1]. The structure has a well-defined, faulted, central elevated area surrounded by largely eroded multiple breccia rings [2]. The breccia rings are separated by crater-fill sediments and suevite (impact melt) deposits. The breccias are mainly monomict breccias that include clasts of dominantly coarse-grained porphyritic granitoid in addition to mylonitized granitoid, vein quartz and supracrustals. Besides, the impact melt breccia contains numerous fragments composed of partially devitrified impact melts that are mixed with unshocked as well as shocked, deformed quartz and feldspar clasts.

Although attempted, the actual age of impact for the Dhala Structure is still unknown. The SHRIMP U-Pb zircon data for two breccia samples yield ages of 2563 Ma and 2553 Ma, which indicate the age of granitoid basement [3]. The high-resolution ^{40}Ar/^{39}Ar step heating experiments result partial plateau ages indicating that the Dhala impact melt rock was affected by a strong thermal/hydrothermal overprint at ca. 1 Ga [3]. The SHRIMP U-Pb ages for two zircon overgrowths also indicate a ca. 530 Ma event that may have contributed to the post-impact resetting of the impact melt rock [3].

Any rock magnetic data of the Dhala Structure and its target rocks, however, are still awaiting. In the present abstract, we report our preliminary results on Anisotropy of Magnetic Susceptibility (AMS) analyses of both unshocked and shocked granitoid target rocks, monomict breccias and impact melt breccias collected from around this structure.

Sampling and analytical techniques: Oriented rock samples of unshocked and shocked target granitoids, monomict breccia and impact melt breccia were collected from 15 sites around the Dhala Structure. The AMS measurements were carried out by an AGICO KLY-2 Kappabridge instrument at Dr. KSKGRL, IIG, Allahabad, with an alternating field intensity of 300 A/m & operating frequency of 875 Hz.

Experimental results: In equal-area projection, the AMS axes of apparently unshocked target granitoid samples show a roughly triaxial distribution, although our limited data show variations in orientation (Fig. 1). Similarly, our shocked granitoid target samples show a triaxial distribution of data in equal-area projection where a majority of K_2 axes are oriented subvertical (Fig. 2).

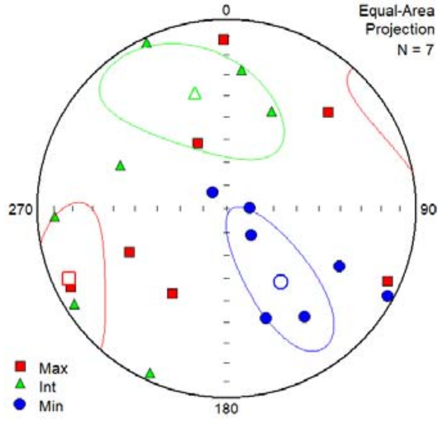

Fig. 1. Equal-area projection of AMS axes of unshocked granitoid target, Max, Int, and Min are K_1, K_2 and K_3 AMS axes, respectively.

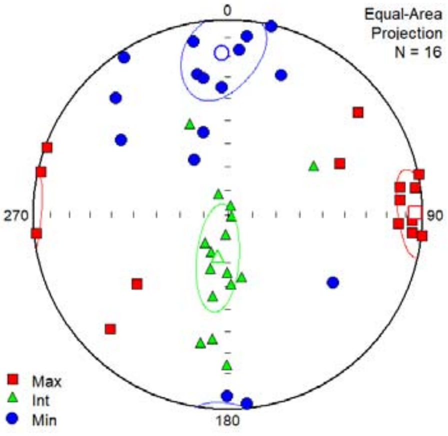

Fig. 2. Equal-area projection of AMS axes of shocked granitoid target, symbols as in figure 1.

In equal-area projections, the K_3 axes of monomict breccia samples are oriented subhorizontally, dipping towards SE, while the K_1 and K_2 axes are broadly distributed on an average subvertical magnetic plane that strikes NE–SW (Fig. 3). Like the shocked granitoids (Fig. 2), the mylonitized monomict breccia samples also show triaxial distribution of AMS axes where the K_2 axes are vertical (Fig. 4). The impact melt breccia samples show subvertical K_3 axes, where K_1 and K_2 axes are distributed on a subhorizontal plane dipping towards NNE (Fig. 5).

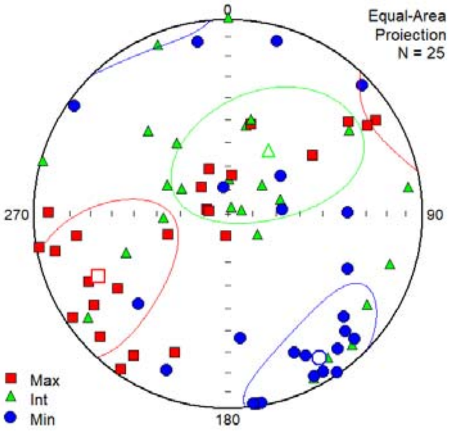

Fig. 3. Equal-area projection of AMS axes of monomict breccia, symbols as in figure 1.

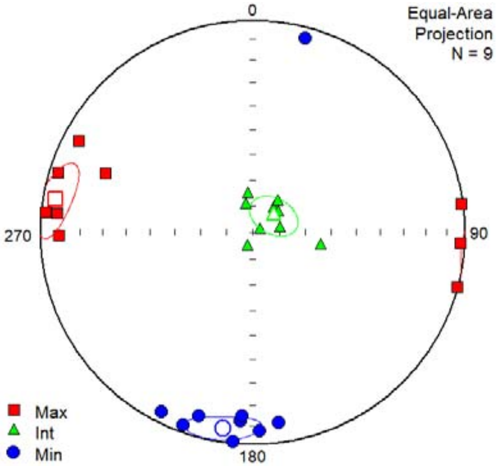

Fig. 4. Equal-area projection of AMS axes of mylonitized monomict breccia, symbols as in figure 1.

Discussion: Our present rock magnetic studies on the Dhala Structure confirms our previous observation on Lonar Crater [4] that due to the effect of shock pressure during impact, the orientation of AMS axes in the target igneous rocks becomes triaxial (Fig. 1, 2). A very prominent triaxial distribution of AMS axes is also observed for the mylonitized monomict breccia (Fig. 4).

The distribution of AMS axes in the monomict breccia and impact melt breccia in equal-area projections are technically similar (Fig. 3, 5). Both of them show point concentration of K_3 axes, whereas K_1 and K_2 axes are distributed on girdles, although orientations of axes are completely different. However, between these two impactites, the chilling of impact melt is definitely a post-impact phenomenon, and it can be concluded that a limited subhorizontal flow of this silicate melt prior to its chilling have resulted in vertical K_3 axes and subhorizontal K_1 and K_2 axes where the latter two axes are distributed on a girdle [5].

However, the significance of equal-area projection distribution of AMS axes for the monomict breccia (Fig. 3) is not completely understood. This fabric can also be interpreted as a triaxial distribution of AMS axes where K_2 axes are orientated subvertical, whereas the K_1 and K_3 axes are subhorizontal and oriented towards SW and SE respectively, although important overlap in their distribution exist. Finally, the present observations suggest that there are important variations in AMS axes in the target granitoid rocks and impactites in the Dhala Structure, and a more detailed study on these variations could shed light into a more detail impact history of this crater.

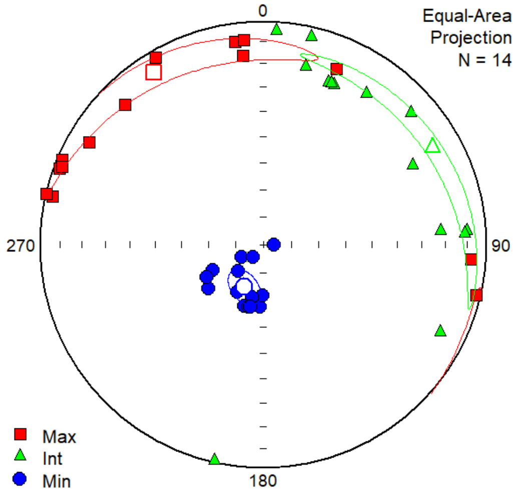

Fig. 5. Equal-area projection of AMS axes of impact-melt breccia, symbols as in figure 1.

References: [1] Pati J. K. et al. (2008) *4th Large Meteorite Impacts & Planet. Evol.*, Abstract #3041. [2] Pati J. K. et al. (2008) *Meteoritics & Planet. Sci., 43,* 1383–1398. [3] Pati J. K. et al. (2010) *GSA Special Paper, 465,* 571–591. [4] Arif Md. et al. (2012) *Meteoritics & Planet. Sci., 47,* 1305–1323. [5] Cañón-Tapia E. et al. (1997) *JVGR, 76,* 19–46. [6] Misra S. et al. (2010) *GSA Bulletin, 122,* 563–574.