Shock-induced deformations in feldspar grains from Siljan impactites (Sweden)

Holm, Sanna1; Ferrière, Ludovic2
1 Department of Geology, Lund University, Sölvegatan 12, SE-223 62 Lund, Sweden; sanna.holm@geol.lu.se
2 Natural History Museum, Burgring 7, A-1010 Vienna, Austria (ludovic.ferriere@univie.ac.at).

Various shock-induced deformations are known from both alkali feldspars and plagioclase, including, with increasing shock pressure, fracturing, plastic deformation, planar fractures (PFs), or more frequently planar deformation features (PDFs), and at high pressure regimes diaplectic glass. However, these features have been much less studied and characterized than corresponding features in quartz. Therefore, they have not traditionally been used as indicators of meteorite impact. Increasing the knowledge of shock-induced microscopic deformation features in feldspars is especially of interest in the case of study of extra-terrestrial material, as quartz is generally lacking in these rocks. In addition, with the current state of knowledge on impact metasomatism of feldspar, impact structures formed in targets devoid of quartz are hard to confirm.

We present here preliminary results from a petrographic study of feldspar grains in shocked granitic rocks from the Siljan impact structure (Sweden). Quartz crystals in these samples were previously studied in detail, and used for assigning shock pressures to localities across the structure by Holm et al. (2011). Our observations show that planar microstructures, including fracturing, plastic deformation, PFs and PDFs occur in alkali feldspar grains from localities estimated to have been subjected to a pressure range of 10-20 GPa. Feldspar in samples subjected to pressures below this range display no obvious shock-induced planar microstructures. Most of the plagioclase feldspar grains are strongly altered to sericite and clay minerals throughout all the investigated samples, hampering study of them. However, in grains that are somewhat less altered, no obvious planar microstructures were seen, suggesting that something higher pressure is possibly required for their formation in plagioclase feldspars. Further investigations will be necessary to confirm this observation.

References

Direct mineral melting in the Maniitsoq structure, West Greenland

Keulen, Nynke1; Garde, Adam A.2; Johansson, Leif3
1 Geological Survey of Denmark and Greenland (GEUS), Øster Voldgade 10, 1350 Copenhagen K, Denmark; aag@geus.dk;
2 Department of Geology, Lund University, Sölvegatan 12, SE-223 62 Lund, Sweden;
3 Department of Earth Sciences, University of Stellenbosch, Private Bag X1, Matieland 7602, South Africa; klausen@sun.ac.za.

The newly discovered 3.00 Ga old Maniitsoq impact structure in southern West Greenland overlaps geographically with contemporaneous, Ni-mineralised norites and with two ~800 Ma younger, conjugate clusters of boninitic norite (BN) dykes. A straightforward explanation for this geographic linkage between the Maniitsoq impact and later-stage BN magmatism is that the impact must have been large enough to physically mix continental crust down into the underlying sub-continental lithospheric mantle, thereby creating an impact-modified mantle spot, that when perturbed later by thermal events produced the BN intrusions. BN intrusions, similar to the West Greenland ones, have been emplaced worldwide between 2.9-2.0 Ga. The intrusions are of considerable economic interest as the BN-magmas are thought to have been parental to some of the most significant magmatic Ni, Cu, PGE and Cr deposits on Earth. The BN intrusions have hitherto been interpreted as either komatiitic, high-degree partial mantle melts that were subjected to contamination by large volumes of Archaean crust, or as more moderate-degree partial melts from a highly depleted, fossilized mantle wedge that had been enriched by slab-derived adakitic melts. Our interpretation of the southern West Greenland BN intrusions offers a new and alternative petrogenetic model for BN-intrusions, i.e., being the result of a meteorite impact modified mantle.

In the present study we review the special field relationships and petrographical/geochemical characteristics of the southern West Greenland BN dykes, which lead us to suggest a meteorite impact modified mantle origin. We also explore other BN-provinces across the World and discuss if they might have similar, yet undiscovered links to impacting.

Ni-mineralised norites and post-kine- matic diorites from the Maniitsoq area, southern West Greenland: Evidence for impact-related source modification

Kokfelt, Thomas E1; Garde, Adam A.; Pattison, John2; MacDonald, Ian3
1 Geological Survey of Denmark and Greenland, Øster Voldgade 10, DK-1350 Copenhagen K, Denmark; E-mail: tfk@geus.dk;
2 North American Nickel Inc., 301-260 W. Esplanade, North Vancouver, BC V7M 3O7, Canada;
3 School of Earth and Ocean Sciences, Cardiff University, P.O. Box 914, Cardiff, CF10 3YE, UK.