Whole-rock Geochemistry of Impactites and Crystalline Basement-derived Lithologies from the ICDP-USGS Eyreville Drill Cores, Chesapeake Bay Impact Structure, Virginia/USA

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The Chesapeake Bay impact structure (Ø 85 km, 35.5 Ma old) was drilled in 2005-6 by ICDP-USGS. These drill cores comprise post-impact sediments, impact-induced resurge sediments (Exmore beds, 444.9 – 1095.7 m) containing the Exmore breccia (diamicton), lithic blocks (1095.7 – 1397.2 m) including a 274 m thick granitic megablock (1097.7 – 1371.1 m), impact breccias (1397.2 – 1551.2 m), and crystalline basement-derived rocks (1551.2 – 1766.3 m) (Gohn et al., 2006; Horton et al., 2008). The whole-rock chemical compositions of Exmore breccia, impactites, and crystalline basement-derived lithologies were investigated by XRF and INAA (320 samples), in order to understand mixing relationships of impact-generated rocks and resurge sediments.

The major crystalline basement-derived lithologies in this drilling comprise granite, granitic gneiss, amphibolite of lithic block section, cataclastic/felsic gneiss of impact breccia section, and schist, pegmatite/granite of crystalline block section. These lithologies were characterized by average composition and compositional range.

The Exmore breccia is subdivided, based on chemical observations, into five units: (1) 444.9 – 450.7 m, (2) 450.7 – 468 m, (3) 468 – 518 m, (4) 518 – 528 m, and (5) 528 – 864 m. Units (2) and (4) display distinctly lower $SiO_2/(Al_2O_3+Fe_2O_3+MgO)$ ratios compared to the other units. Both units show enrichments of TiO_2, Sc, V, Cr, and Zn compared to the other units; P_2O_5 is distinctly enriched at the top of unit (2). Besides mafic basement schist and granitic components, the Exmore breccia contains a significant amount of a SiO_2-rich target component of sedimentary origin - not recognized in the compositions of the impactites.

The chemical compositions of suevite, impact melt rock, and polymict lithic impact breccia are similar, overlap with the field of Exmore breccia, and can be regarded as mixtures of mafic basement schist with granitic and/or sedimentary components. In general, the impactites display a slightly negative correlation of SiO_2 and CaO contents with depth, whereas TiO_2, Al_2O_3, Fe_2O_3, and MgO contents are positively correlated with depth. This could be the result of increasing amounts of mafic basement schist and decreasing sedimentary and/or granitic components with depth. Na_2O is distinctly enriched in the suevite units S3 and S2 (1407.5 – 1450.2 m), which could be caused by a higher granitic component within these units compared to the other units.

References

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