INTER-ELEMENT FRACTIONATION PROCESSES BETWEEN TARGET MELTS, PROJECTILE MATTER AND SHOCKED QUARTZ IN CRATERING EXPERIMENTS.

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Introduction: The detection of meteoritic components in impact-derived rocks is of great diagnostic value for confirming an impact origin [1]. The processes of mixing projectile matter into target and impactite materials are far from being understood. We present results of hypervelocity cratering experiments using a natural sandstone target and iron meteorite matter as projectile.

Experiments have been performed at the two-stage acceleration facilities of the Fraunhofer **E**rnst-**M**ach-**I**nstitute (Freiburg, GER). Our results are based on experiment #3298 [2] using a Campo del Cielo meteorite sphere projectile (Ø 10 mm) accelerated to ~4.5 kms^{-1} (E_{kin} ~43 kJ) and as target a 50x50x50 cm block of Seeberger Sandstone. Ejecta material was captured with a catcher system [3] and analyzed by an electron microprobe.

Results: The ejecta fragments show metamorphic shock features (PDFs in Qtz, diaplectic glass, lechatelierite) and partial melting of the clay-bearing sandstone matrix, which involves Qtz too. Droplets of projectile have only entered the sandstone melt.

Projectile residues occur as spheres, spheroids or partly molten fragments in the ejecta. The residues are enriched in Ni and Co and depleted in Fe compared to the Campo del Cielo meteorite. The spheres vary strongly in composition (Ni: 5.6-17.3 wt.%, Co: 0.4-1.3 wt.%, Fe: 77.7-94.0 wt.%). Enrichment of Ni and Co versus Fe correlates negatively with the sphere-size.

Sandstone melt consists of SiO_2 (51-94 wt.%), (1.9-17 wt.%), FeO (4.5-32 wt.%), and NiO (0.01-0.9 wt.%). Components of this mixture are Qtz, clay-bearing sandstone matrix (with FeO=3.2 wt.%) and up to ~20% projectile matter. The Fe/Ni-ratio of the sandstone melt is generally below the projectile ratio.

Shocked quartz with PDFs, diaplectic glass and lechatelierite contain slightly FeO (<1.7 wt.%) and NiO (< 0.08 wt.%). The average FeO content of the high-shocked Qtz is 0.58 wt.%.

Discussion: Our analyses suggest inter-element fractionation between projectile and target in different impact stages. (A) After shock compression with formation of PDFs in Qtz, diaplectic glass or lechatelierite, and during early unloading, <1 % of projectile matter is added to the glass phases without detectable fractionation. (B) Later, when waste heat triggers melting of the sandstone, molten projectile is mixed with the sandstone melt and significant element fractionation occurs. Fe is selectively enriched in the silicate melt; Ni and Co are enriched over Fe in coexisting projectile spherules. Comparable processes have been reported in natural impactites [4-6]. The increase of fractionation with decreasing spheres-size shows that the fractionation of Fe, Ni, and Co occurs during solution of the metal spheres in the silicate melt due to differences in chemical reactivity [6].

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