ELEMENT PARTITIONING PROCESSES BETWEEN IRON-RICH PROJECTILES AND SILICA-RICH TARGETS IN HYPERVELOCITY IMPACT EXPERIMENTS. M. Ebert[1], L. Hecht[1], A. Deutsch[2], T. Kenkmann[3] [1]Museum für Naturkunde Berlin, D-10115 Berlin, Germany (matthias.ebert@mfn-berlin.de); [2]Institut f. Planetologie, WWU Muenster, D-48149 Muenster, Germany; [3]Institut für Geo- und Umweltnaturwissenschaften, ALU Freiburg, D-79104 Freiburg.

Introduction: The investigation of projectile traces in impact materials is of great value for confirming a impact origin and for reconstructing the type of extraterrestrial material that penetrated the Earth [1]. In this study we present experimental results about how impact energy, water-saturation of the target, and target porosity affect (i) projectile dissemination into the various impactites, and (ii) partitioning of projectile elements during mixing of projectile and target melts.

Experimental setup: In the context of the MEMIN program [2], we have performed impact experiments at the two-stage acceleration facilities of the Fraunhofer Ernst-Mach-Institute (Freiburg, Germany) using steel D290-1 projectiles, and targets of quartzite and quartz-rich sandstone blocks; some of the latter have been saturated with water. Projectile masses of 0.067 and 7.323 g and an impact velocity of about 5 $km*s^{-1}$ result in impact energies of ~0.76 kJ and 81 kJ, respectively.

Results: During the high dynamic cratering process a large number of molten projectile droplets were incorporated into melts of target material. In general a metal melt coexist with a silicate melt, although the latter may exhibit further separation into immiscible melts at the sub-µm scale (see below).

Element partitioning processes: The target and projectile melts have experienced significant chemical modifications during the impact. Interelement ratios of the projectile tracers Cr, V, Co, Mo, and W within the contaminated target melts are strongly modified from the original ratios in the steel. This fractionation process is most likely the result of differences in the lithophile or siderophile character of the projectile tracer elements, or more precisely, of differences in their reactivity with oxygen [2] during interaction of metal melt with silicate melt. The element map in Fig. 1 clearly shows that Cr (and V) of the projectile droplets nearly totally partition into the quartzite melt, whereas the siderophile Co (Mo and W) almost entirely remain in the projectile droplets. The element ratios in the original steel are significantly changed within the projectile melt droplets.

Effects of experimental conditions: Several impact experiments were carried out with a quartzite target with almost no *porosity*. Electron microprobe investigations of highly shocked ejecta from these experiments suggest enhanced element fractionation processes during the impact compared to the experiments with the sandstone target (0% vs. ~23 % porosity). Partitioning of the projectile elements Cr, V, and especially Fe into the target melt is more enhanced in experiments with quartzite compared to those with sandstone. Some metal droplets are surrounded by a Fe-rich silicate melt (*Lfe*; Fig.1) and small Cr-V-rich minerals (probably spinels). These *Lfe* rims and the Cr-V-rich minerals, however, are completely absent in sandstone experiments at similar impact velocities. Furthermore, the highly shocked ejecta of the quartzite target has a higher amount of silica glasses, a lower content of projectile droplets, and shows often melt textures suggesting liquid immiscibility between Fe-rich and Si-rich silicate melts. Similar features were described for melt rocks of the Wabar crater [3].

The geochemical processes between projectile and target melts were obviously not affected by the degree of *water-saturation* and by the *impact energy*. This is true at least for the applied experimental conditions.

Conclusions: Our laboratory experiments yield results very similar to observations in nature, e.g., at Meteor Crater and the Wabar craters [3, 4]. From our perspective, small scale geochemical processes, like (i) partitioning of projectile elements into target melts, (ii) the associated phase separation into Fe-rich and Si-rich melts, and (iii) strong alteration of the ratios of meteoritic tracer elements in impact melts from the respective ratios in the projectile seem to be common feature during mixing of projectile and target melts.

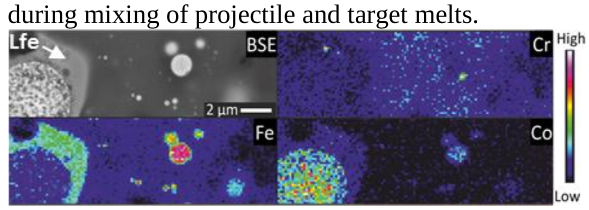

Fig. 1 WDX element maps of a highly shocked ejecta fragment with quartzite melt (dark grey), *Lfe* rim and steel projectile droplets (whitish spheres).

References: [1] Palme H. et al. (1981) *GCA* 45, 2417-2424 [2] Ebert M. et al. (2013) *MAPS* 48, *134-149* [3] Hamann C. et al. (2012) *EPSC* 2012, Abstract #2012-745-1. [4] Mittlefehldt D.W. et al. (2005) *GSA SP* 27, 367-390.

Acknowledgements: This work is supported by the German Science Foundation DFG (He-2893/8-1, Ke-732/18-1, DE-401/23-1).