LIQUID IMMISCIBILITY AND DISEQUILIBRIUM TEXTURES IN QUENCHED IMPACT MELT OF THE WABAR AND TENOUMER CRATERS.

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Introduction: Preserved heterogeneities in quenched impact melt may serve as a tool to better understand its genesis. Heterogeneity of impact melt may have several reasons including incomplete homogenization of target lithologies, variation in the amount of admixed meteoritic material, as well as subsequent fractionation or alteration process during cooling and crystallization [1]. Liquid immiscibility has rarely been described for impact melts but is likely more common than previously thought. Impact melt of two craters or crater fields have been studied to better understand the causes of impact melt heterogeneity and the processes of chemical target-projectile mixing.

Wabar impact melt: The impact glass sample from the Wabar craters (Saudi Arabia) is composed of a highly siliceous, vesicular, and texturally heterogeneous glass with flow bands and schlieren of more or less Fe-rich glass that resembles the black melt variety of [2]. In detail, Wabar black melt is composed of an emulsion of three compositionally different melts that quenched to a phase-separated glass (Fig. 1): It is dominated by a highly siliceous glassy matrix (Lsi) that contains ubiquitously and homogenously dispersed droplets and spheres of a Fe- and Ca-rich ultrabasic glass (Lfe), and numerous, but lesser frequent, metallic FeNi-spheres. Around large FeNi-spheres (>10 μm), corona-like structures occur (Fig. 1) composed of Lfe with ~20 vol% of small (1–4 μm) Lsi droplets. These textures suggest that significant amounts of Fe were supplied from the meteoritic FeNi-spheres when they mechanically mixed with target melt. The strong increase in Fe induced liquid immiscibility with various ratios of Lfe/Lsi.

Tenoumer impact melt: Impact melt bombs from the Tenoumer crater (Mauritania) range from andesite to basaltic andesite in composition and were mainly formed from a mixture granitoid and mafic target rocks [3,4]. Depending on the whole rock composition the impact melt is composed of various amount of mainly plagioclase (pl), clinopyroxene (cpx), orthopyroxene (opx), olivine (ol), fe-oxides, and interstitial glass. The textures (e.g. atoll-shaped olivine, acicular px and pl) and mineral assemblages indicate strong disequilibriaum conditions during crystallization. Rapid crystallization was also likely the cause of phase separation into a Ca- and Fe-rich melt (Lfe) and a Si- and K-rich melt (Lsi) observed within the interstitial glass matrix (Fig. 2). Furthermore, the Lfe may itself show crystallization of Ca-Fe-rich minerals.

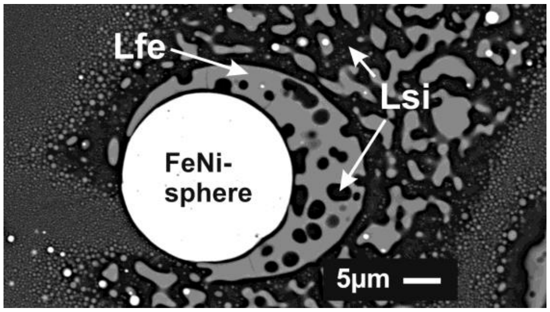

Fig.1 BSE image of Wabar impact glass. Abbreviations see text.

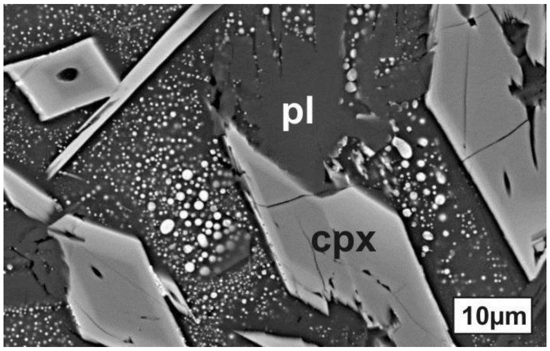

Fig.2 BSE image of Tenoumer impact melt rock. White droplets are Lfe in Lsi. Abbreviations see text.

Conclusions: Phase separation into coexisting liquids may occur if the melt composition is shifted (towards a two-liquid field) due to mixing of different target rocks or rapid crystallization as in the case of the Tenoumer impact melt. In case of the Wabar impact melt liquid immiscibility is a consequence of chemical interaction between projectile (Fe meteorite) and target melt that were mechanically mixed during or before cooling. The emulsion textures and relative proportions of Lfe and Lsi document the successive supply of the meteoritic material and associated chemical fractionation processes.

References: [1] Koeberl C. et al. (2013) *Elements, 8*, 37-42. [2] Hörz F. et al. (1989) *Proc. Lunar Sci. Conf. 19th*, 697–709. #1522. [3] Pratesit G. et al. (2005) *Meteoritics & Planet. Sci., 40*, 1653-1672., [4] Fudali R.F. (1974) *J. Geophys. Res., 79*, 2115-2121.