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Phenocrystal variations in melt rocks from Tenoumer impact crater, Mauretania: indicators for varying target contribution and melt mixing.

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Impact melt rocks from the relatively small (1.9 km in diameter) Tenoumer impact crater (Mauretania) show heterogeneities regarding whole rock chemistry, lithoclast components, their shock deformation degree, amount of vesiculation (melt degassing), and contribution of carbonate melt phases mingled into silicate melt matrix. These heterogeneities have two main reasons: First, due to the restricted size of the impact crater there was probably no coherent melt pool where a homogeneous mixture of the target rocks could be achieved. Therefore, impact melting of target lithologies resulted in locally different, often incomplete mixing of melts from chemically very diverse target rocks. Second, melt rock heterogeneity occurs at the thin section scale and is due to fast cooling during and after the dynamic ejection and emplacement process. The overall period of crystal growth has been extremely short, so that chemical equilibration of the phases could not be achieved. Melt mixing processes involved in impact melt formation are, thus, recorded in non-equilibrium growth features. Mixing processes between chemically different melt phases and the formation of hybrid melts can be observed in the case of Tenoumer impact melts on a millimeter scale. Due to extreme cooling rates, different mixing stages are preserved in the varied parageneses and mineral chemistry of phenocrysts.

Different silicate melt matrices show different phenocryst parageneses in response to slight variation of whole-rock chemistry and, thus, represents a useful indicator of precursor rock contribution to different impact melts. Basalt-andesitic (Mg,Fe-rich) melt matrices are after all composed of up to 20 vol% of forsterite-rich olivine-microphenocrysts. Decreasing Fe,Mg-amounts of melt matrix results in decreasing modal abundance of olivine, which shows progressively higher fayalite composition. These observations correlate with changing amounts of felsic and basic lithoclasts (granite, granitic gneiss, and gabbro). Different pyroxene generations occur including significant compositional zonation with widely variable CaO, MgO and FeO contents (En_{7-80}, Wo_{4-50}, Fs_{9-41}). Pyroxene evolution (core-rim-zonation) changes from En-Di to Di-Hd as CaO content of the melt matrix oversteps 9 wt%. Strong variations in CaO content that do not correlate with increasing MgO and FeO contents are interpreted as incorporation of CaO from carbonate melts into the silicate melt phase. The presents of intermingled carbonate melt schlieren support this hypothesis.

New $^{40}Ar/^{39}Ar$ dating on three of the studied melt rock samples resulted in a - preferred - age of 1.57 $\pm$ 0.14 Ma for the Tenoumer impact event. This impact age is significantly different from previous dating results of 21 $\pm$ 10 ka and 2.5 $\pm$ 0.5 Ma.