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Petrology of impact melt bombs from Tenoumer impact crater, Mauritania

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The petrology of impact melt bombs collected at the outer slope of the crater of the relatively small Tenoumer impact crater (1.9 km in diameter) in the Western Sahara desert of Mauritania has been studied by means of whole rock and micro-chemical analysis. The impact melt rocks cover a range of intermediate compositions from andesite to basaltic andesite, as previously reported by Fudali (1974) and Pratesi et al. (2005). This chemical diversity results from the sample-to-sample variation with regard to the relative proportions of more mafic and more siliceous target rocks (mainly granitoids or gneisses and amphibolite, with additional limestone, mica schist and ultrabasites - Pratesi et al. 2005). Some mafic clasts suggest that more or less metamorphosed olivine gabbro was also part of the target lithology. Electron microprobe studies of nine melt rock samples show that heterogeneous melt matrix crystallisation patterns are related to variations in whole rock chemical composition. More Mg- and Fe-rich melt matrices are composed of ca. 25 vol% residual glass, with 30 vol% pyroxene, 25 vol% plagioclase, 1-5 vol% Fe-oxide , and up to 20 vol% olivine (Fo65-76, Fa24-35) microphenocrysts. Two stages of pyroxene growth are represented by enstatite crystal cores and augite overgrowths. Microtextures suggest that cpx apparently crystallized after ol and opx, but contemporaneous with or prior to plagioclase. Decreasing Fe- and Mg contents of melt matrix result in decreasing modal content of olivine and increasing content of glass. In melt rocks with less than 6 wt% of FeOtot and 4 wt% MgO, olivine phenocrysts and Fe-oxides are absent. At low Fe and Mg, but rather high Ca contents of the melt matrix, pyroxene consists of diopside cores and hedenbergite rims. The latter developed after plagioclase growth. All textures are typical for fast cooling, as exemplified by atoll-shaped olivine, or acicular pyroxene and plagioclase. Textures and modal abundances (e.g., olivine microphenocrysts occurring adjacent to quartz fragments or lechatelierite) indicate strong disequilibrium conditions during melt crystallization. The heterogeneity of the Tenoumer melt rock samples has two main reasons. First, impact melting of target lithologies resulted in mixing of different target rocks only on a local scale. There was probably no coherent melt pool representing a homogeneous mixture of all target rocks. Second, melt rock heterogeneity occurs at the thin section scale and is due to fast cooling with disequilibrium crystallization conditions, during and after the dynamic ejection and deposition of the melt bombs.

Fudali R. F. (1974): Genesis of the melt rocks at Tenoumer crater, Mauritania. Journal of Geophysical Research 79, 2115–2121.
Pratesi, G., Morelli, M., Rossi, A.P., Ori, G.G. (2005): Chemical compositions of impact melt breccias and target rocks from the Tenoumer impact crater, Mauritania. Meteoritics & Planetary Science 40, 1653–1672.