# The complex history of an olivine-rich diogenite NWA 5480

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**Introduction**

Expectations regarding structural deformation of asteroidal meteorites have typically revolved around impact-induced shock metamorphism or the gravity-driven axial compression of cumulates at the base of magma chambers. Recent structural analyses [1], however, of several olivine-rich diogenites (harzburgites) reveal solid-state plastic deformation not attributable to either scenario and propose dynamic mantle movements in the parent body, assumed to be the asteroid 4 Vesta. In this study we examine the microstructures and the chemistry of pyroxene and olivine in the complex olivine-rich diogenite NWA 5480, consisting of a dunitic zone A and a harzburgitic zone B, to gain further insight into its complex history. Analytical methods include scanning electron microscopy (SEM), electron backscattered diffraction (EBSD), electron probe microanalysis (EPMA) and transmission electron microscopy (TEM).

**Results**

A coarse-grained, poikilitic texture was observed in the pyroxene that also displayed relatively wide augite exsolution lamellae. Four populations of olivine were established involving several morphologies and grain sizes, yet at least three of the four olivine populations showed little or no chemical deviation. No shock effects were observed.

**Conclusions**

Together with the reported solid-state plastic deformation [2] these results attest to polyphase deformation and heating events as well as relatively slow crystallisation and sub-solidus cooling rates. Observations suggest that impact events alone are unlikely to generate and sustain the thermal and deformation conditions required to achieve all of the observed features. The proposed dynamic mantle movements [2] in the Vestan interior offer a means of heat transport to the system likely sufficient to provide a thermal environment inducive to slow cooling as well as generate the incremental stress fields required for the polyphase plastic deformation observed in the olivine.

[1] Tkalcec & Brenker (2014) *MAPS*, **49**, Nr 7, 1202–1213; [2] Tkalcec et al. (2013) *Nature Geosci.*, **6**, 93-97.