OLIVINE DECOMPOSITION FEATURES IN THE Y000593 AND NWA998 NAKHLITES.

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Introduction: Olivine grains within the 6 nakhlites show signs of partial breakdown both from limited exsolution and through a later, low-temperature, rapid brine-evaporation event associated with fracture-filling siderite-clay mixes e.g. [1,2]. We report results of EPMA and analytical-TEM with focused ion beam sample preparation studies of Y000593 and NWA998 in order to characterise olivine-decomposition in the nakhlites.

Results: We have identified exsolution lamellae composed mainly of stoichiometric Ca-rich olivine within Y000593 olivine grains. They have a similar dark brown, oxidised appearance in ppl as augite-magnetite symplectites in Nakhla and are typically 50 x 5 m. Their compositions are Mg* = 28-33, Ca/(Ca+Mg+Fe) = 0.16-0.28 with CaO = 9-16 wt%. The CaO contents of the surrounding olivine are 0.6 wt%. However, some exsolution lamellae in Y000593 are composed of augite (En29-39 Fs23-33 Wo38-40).

The carbonate-clay intergrowths in Y000593 and NWA998 are too fine-grained to allow for pure carbonate analyses to be determined by EPMA. Therefore we determined a range of clay-carbonate mix compositions and by extrapolation the 0 wt% SiO_2 end-member was taken as the carbonate composition. The Y000593 carbonate is Cc 7.3%, Rh 1.9%, Mg 13.9%, Sd 76.9%. This is similar – although in the lower range of Mn contents – to that described in Nakhla and Governador Valadares (GV) [1]. Siderite in Nakhla [1] has an overall range of Cc 0.1-5.7%, Rh 1.0-39.9%, Mg 2.0-40.9%, Sd 23.2-87.0%. Both GV and Nakhla contain carbonate and related minerals within interstitial, mesostasis areas in addition to fractures within olivine [1]. We have found no interstitial siderite in Y000593 or NWA998.

Two <20 m samples were separated from siderite-clay veins in Y000593 by a focused ion beam technique [3]. ATEM analyses of the samples confirm the presence of crystalline siderite. They reveal the amorphous nature both of the Fe-rich clay and also some of the olivine immediately surrounding the veins in zones <5 m wide. Whether this is related to fracturing, limited alteration by the brine or are an artifact of the ion beam is not yet clear.

Discussion: Symplectite exsolutions described in Nakhla are considered to be formed from the breakdown of Ca-rich olivine to augite and magnetite [2]. Our discovery of Ca-rich olivine exsolutions in Y000593 may be due to fast cooling in an upper part of the nakhlite cumulate pile as suggested by [4]. Initial REE data we are collecting e.g. [5] may be consistent with a slightly more evolved melt composition than Nakhla and we are exploring this question further. Siderite composition in Y000593 is consistent with the metastable carbonate compositions in nakhlites [1,6] formed through rapid evaporation of a brine.

References: [1] Bridges J. C. and Grady M. M. 2000. *Earth Planet. Sci. Lett.* 176, 267-279. [2] Mikouchi T. et al. 2000. *Meteoritics & Planetary Science* 35, 937-942. [3] Lee M. R. et al. 2003. *Mineralogical Magazine* 67, 581-592. [4] Mikouchi T. et al. 2003. Antarct. Meteorite Res. 16, 34-57. [5] Bridges J. C. et al. 2000. *Meteoritics & Planetary Science* 38, A119. [6] Bridges J. C. et al. 2001. *Space Science Reviews* 96, 365-392.