DISCOVERY OF A MG-DOMINANT ANALOG OF KAMIOKITE, $MG_2MO_3O_8$, A NEW MINERAL FROM AN ALLENDE TYPE B1 CAI.

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Introduction: During a nano-mineralogy investigation of the Allende meteorite, two occurrences of a new Mo-Mg oxide mineral, $Mg_2Mo_3O_8$, which we designate kamiokite-(Mg) for the purposes of this abstract, were discovered in a Type B1 Ca-, Al-rich inclusion (CAI). The Mg analog of kamiokite ($Fe_2Mo_3O_8$) has a $P6_3mc$ structure and it occurs in the same CAI as a variety of other newly-observed meteoritic minerals described by [1].

Occurrence, Chemistry, Crystallography: One subhedral grain of kamiokite-(Mg) [$(Mg_{1.6}Fe_{0.4})Mo_3O_8$], ~ 1.0 μm wide, occurs within a 3x5 μm inclusion dominated by a single crystal of fcc Ni-Fe alloy ($Ni_{82}Fe_{15}Pt_2Rh_1$) wholly enclosed in $MgAl_2O_4$ spinel. The kamiokite-(Mg) is in contact with the Ni-rich alloy. The other kamiokite-(Mg) grain, in a different section of the same CAI, is 0.5x1.0 μm, roughly centered in a 3x4 μm phase assemblage partially enclosed by spinel and partially enclosed by alteration material after melilite. Apatite is in contact with the alteration and Ni-Fe alloy, which contains inclusions of Ru-Os alloys and Mo-bearing oxides, is in contact with spinel.

Electron backscatter diffraction patterns of kamiokite-(Mg) were matched to the $P6_3mc$ structures of kamiokite and synthetic $Mg_2Mo_3O_8$. The best fit (MAD = 0.41) was achieved using structural data for $Mg_2Mo_3O_8$ [2], with a =5.778 Å, c = 9.904 Å, V= 286.35 Å^3, Z = 2.

Origin and Significance: Where present as part of phase assemblages predominately or wholly included in melilite, kamiokite is Fe-rich (Mg/Fe molar < 0.2) and coexists with or is in close proximity to a Ni-Fe alloy. Kamiokite-(Mg) also coexists with Ni-Fe alloys but the assemblages are partially or wholly included in spinel and the high Mg/Fe (~4) may reflect local buffering of Mg by the surrounding Mg-rich spinel. Fe-Ni alloy compositions also reflect occurrence, with Ni/Fe highest (~5) in the assemblage wholly included in spinel, lower in the assemblage partially exposed to alteration (~3) and lowest in assemblages wholly included in melilite (~2). We observed P-rich phases in half of the kamiokite (3 of 6) and kamiokite-(Mg) (1 of 2) bearing phase assemblages. It is possible that all of these assemblages contain P-rich phases but that they are often absent in our samples due to sectioning effects.

A scenario for the formation of kamiokite and kamiokite-(Mg) is that a precursor consisting of a Mo ± P-rich alloy was oxidized during alteration to produce the observed suite of oxides and alloys ± phosphates. Both kamiokite-(Mg)-bearing phase assemblages exhibit angular faces that intersect at high angles (~150°), possibly indicating that the current multi-phase assemblages are pseudomorphs after an original single crystal. Mo was preferentially oxidized with compositions of the resulting oxide(s) dictated by local constraints on Mg partial pressures. The formation of apatite reflects oxidation and an external source of Ca. The new Mo-Mg-Fe oxides provide new information on post-crystallization processes experienced by Allende CAIs.

References: [1] Ma C. et al. 2009. Abstr. #5090. 72th Ann. Mtg. Met. Soc. [2] Knorr R. and Mueller U. 1995. *Z. Anorg. Allg. Chem.* 621:541-545.