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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) [$(Mg_{1.6}Fe_{0.4})Mo_3O_8$], $\sim 1.0 \mu m$ wide, occurs within a $3 \times 5 \mu m$ 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 $0.5 \times 1.0 \mu m$, roughly centered in a $3 \times 4 \mu m$ 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 $a = 5.778 \text{ \AA}$, $c = 9.904 \text{ \AA}$, $V = 286.35 \text{ \AA}^3$, $Z = 2$.

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 \pm P-rich alloy was oxidized during alteration to produce the observed suite of oxides and alloys \pm phosphates. Both kamiokite-(Mg)-bearing phase assemblages exhibit angular faces that intersect at high angles ($\sim 150^\circ$), 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.

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DIFFUSION OF SOLAR WIND NOBLE GASES FROM GENESIS ALUMINUM COLLECTORSJ. C. Mabry¹, A. P. Meshik¹, C. M. Hohenberg¹, and D. S. Burnett². ¹Washington University, Physics Department, St. Louis, MO, 63130. E-mail: jcmabry@wustl.edu ²California Institute of Technology, 1201 California Blvd., Pasadena, CA, 91125.

Introduction: The Genesis mission collected samples of solar wind (SW) over a two-year period and returned them to earth for high-precision laboratory measurements [1]. The exact temperatures that the collectors reached during exposure to the SW is unknown, however preflight simulations [2] and comparison of measurements from different target materials point to the potential for measurable losses due to thermally activated diffusion. We have conducted a diffusion experiment on a similar time scale as the Genesis mission to determine the diffusion parameters of the aluminum collector materials and to quantify the changes in the measured ratios due to diffusive losses. In this work we have studied the light noble gases: helium, neon, and argon.

Experimental: We baked individual pieces of two different bulk SW collectors—polished aluminum and aluminum on sapphire (AlO₃)—at six temperatures between 160 °C and 360 °C (with a reference group left at room temperature) for 322 days. Then we performed step-wise pyrolysis (200 to 850 °C, 45 min steps) to extract the gas from these samples, measuring the light noble gases released from each step. We analyzed He and Ne together in one mass spectrometer, and cryogenically separated Ar for analysis in a second one, each optimized accordingly.

Results: The measured isotopic ratios (total of all pyrolysis steps) of the unbaked AlO₃ reference sample are: $^3He/^4He = (4.52 \pm .05) \times 10^{-4}$, $^{20}Ne/^{22}Ne = 13.74 \pm .02$, and $^{36}Ar/^{38}Ar = 5.49 \pm .01$. There were significant losses of both 3He and 4He from the baked samples relative to the reference, with more 3He lost than 4He , leading to noticeable isotopic fractionation. Neon measurements show the same general trend as helium, but all measurements are within 3σ of the reference. There were no measurable losses of Ar within statistical errors, and the measured $^{36}Ar/^{38}Ar$ agrees very well with the previously reported value of $5.501 \pm .005$ [3].

The table below gives the estimated upper limit for losses of He and Ne at various temperatures from AlO₃ for the Genesis bulk collector exposure time (852 days).

Table 1.

Temp (°C)	4He loss	$^3He/^4He$ decrease	^{20}Ne loss	$^{20}Ne/^{22}Ne$ decrease	$^4He/^{20}Ne$ decrease
50	8%	3%	1%	–	7%
75	15%	5%	2%	–	13%
100	22%	7%	3%	–	20%
125	30%	10%	4%	–	25%
200	46%	15%	8%	1%	42%

References: [1] Burnett D. S. et al. 2003. *Space Science Reviews* 105: 509. [2] Jurewicz A. J. G. 2002. *Space Science Reviews* 105:535. [3] Meshik A. P. et al. 2007. *Science* 318:433.

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