Palladium-silver systematics in the oldest differentiated planetesimal

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Combined Hf-W and Pb–Pb isotopic data and calculated cooling rates from Muonionalusta, a Group IVA iron meteorite, indicate that it accreted, differentated and cooled within 2-3 Ma after the formation of CAIs [1]. This chronology suggests that its Pd-Ag isotopic systematics hold the potential of better constraining the Solar System initial abundance of ^{107}Pd ($t_{1/2}$ = 6.5 Ma). High-Pd/Ag metal from Gibeon (also group IVA) has given $^{107}Pd/^{108}Pd = (2.40 \pm 0.05) \times 10^{-5}$, but interpreting this ratio as the Solar System initial has been complicated by unsupported radiogenic ^{107}Ag in associated low-Pd/Ag troilite [2,3]. By contrast, a much higher Solar System initial $^{107}Pd/^{108}Pd$ of $(5.9 \pm 2.2) \times 10^{-5}$ was inferred from carbonaceous chondrites [4].

Metal and troilite samples were taken from two slabs of Muonionalusta [1]. Pd and Ag concentrations, determined by isotope dilution, and Ag isotopic compositions, measured on unspiked aliquots, were analyzed using a Nu Plasma MC-ICP-MS [5]. Troilite results confirm that Muonionalusta escaped isotopic resetting by shock [1], and indicate that the Pd/Ag ratio of Muonionalusta parental materials was $\geq$100 times chondritic. Metal compositions represent 1-10% troilite mixed with radiogenic ^{107}Ag, implying that metal and troilite were once isotopically homogenized in a molten core with 6-12% S. Pd-Ag isotopic data from three metal pieces, however, do not lie on a single isochron, but two samples have slopes corresponding to $^{107}Pd/^{108}Pd = (2.33 \pm 0.27) \times 10^{-5}$, within the uncertainty of Gibeon [2,3]; one metal has a slope of 1.58×10^{-5}, implying an age 4 Ma younger than Gibeon.

If the Solar System initial $^{107}Pd/^{108}Pd$ was as high as inferred for carbonaceous chondrites [4], then Muonionalusta Pd-Ag records an age of $\geq$ 8 Ma, inconsistent with the quick formation and cooling required by W and Pb-Pb ages. If the Pd-Ag and Pb-Pb systems closed at the same time and record the same event in Muonionalusta, then these data imply an initial Solar System ratio between 2.6×10^{-5} and 3.0×10^{-5}.

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Distribution and time variation of helium isotope ratios around the source region of the Iwate-Miyagi Nairiku Earthquake in 2008

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The Iwate–Miyagi Nairiku Earthquake in 2008 (M_{JMA}7.2) occurred on June 14th 2008. We monitored the time change for helium isotopic ratios before and after the earthquake, to define the behavior of the upcoming fluid around the source region. The spring water and gas samples were collected in eight localities, only a week after the earthquake [1]. We repeated the sampling over the next two years (after half a year, one year, one and a half years, two years). Compared to the data before the earthquake [2], we found 10-85% increase of $^3He/^4He$ ratio of hot spring gas in five hot springs after the earthquake, suggesting that the upwelling of aqueous fluid containing mantle fluid [1]. The $^3He/^4He$ ratios show a very large change that becomes steady after half a year and increases slowly as a whole in this region following the earthquake. In addition, in order to investigate the diurnal variation of helium isotopic ratios, hot spring water was collected every hour or every three hours for 24 hours in Yabitsu hot spring. The diurnal variation of the $^3He/^4He$ ratio is only about 3%. The $^3He/^4He$ ratios in this region show a significant change after a week, become steady after half a year, and increase slowly as a whole thereafter. This variation is much larger than the diurnal variation, indicating that a gradual upwelling of magmatic fluid still continues in this region.

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