^{182}Hf-^{182}W CHRONOMETRY OF CAIS AND THE AGE OF THE SOLAR SYSTEM

C. Burkhardt[1,2], T. Kleine[1], H. Palme[2], B. Bourdon[1], J. Zipfel[3], J. Friedrich[4], D. Ebel[5]. [1]Institute for Isotope Geology and Mineral Resources, ETH Zürich, Switzerland (burkhardt@erdw.ethz.ch). [2]Inst. Geol. Min., Univ. Cologne, Germany. [3]Forschungsinst. Senckenberg, Frankfurt, Germany. [4]Chem. Dept., Fordham Univ., NY, USA. [5]Am. Mus. Nat. Hist., NY, USA.

Determining the initial ^{182}Hf/^{180}Hf and ^{182}W/^{184}W of the solar system is essential for establishing a precise Hf-W chronology for the accretion and differentiation of asteroids. Ca-Al-rich inclusions (CAIs) are the first solid objects that formed in the cooling solar nebula and as such are ideally suited for determining the initial Hf-W systematics of the solar system. Combined with Hf-W data and precise Pb-Pb ages of angrites, the Hf-W systematics of CAIs can also be used to determine the age of the solar system. This is important because age estimates for the formation of the solar system range from ~4567 [1] to ~4570 Ma [2]. Here we report new Hf-W data for four bulk CAIs and mineral separates from two CAIs from the Allende CV3 chondrite.

CAIs were separated from Allende slices using steel-free tools, cleaned with abrasive paper and in an ultrasonic bath. Fassasite- and melilite-rich separates were obtained using heavy liquids and handpicking. Samples were dissolved and processed using anion exchange chromatography as described in [3]. Measurements were performed using the Nu Plasma MC-ICP-MS at ETH Zürich.

All bulk CAIs have Hf/W and ^{182}W/^{184}W slightly higher than average carbonaceous chondrites [4], but the limited spread in Hf/W precludes determining a precise Hf/W isochron for bulk CAIs. In contrast, fassaites exhibit high Hf/W and radiogenic ^{182}W/^{184}W, whereas melilites have low Hf/W and ^{182}W/^{184}W. This permits determination of precise internal isochrons. Our new data combined with earlier reported data define an isochron (MSWD=0.65) with initial ^{182}Hf/^{180}Hf=(1.01±0.05)×10^{-4} and initial ε_W=-3.32±0.14 (ε_W is the deviation of ^{182}W/^{184}W from the terrestrial value in parts per 10^4). All uncertainties are 2σ. These new values are identical to but a factor of ~2 more precise than an earlier estimate [4].

Relative to the angrite D`Orbigny with an initial ^{182}Hf/^{180}Hf=(7.4±0.2)×10^{-5} [5] and a Pb-Pb age of 4564.48±0.24 Ma [6] the initial ^{182}Hf/^{180}Hf for CAIs reported here corresponds to an absolute age of 4568.5±0.8 Ma. A similar result of 4568.8±1.0 Ma is obtained relative to the angrite Sahara 99555. The absolute age of 4568.5±0.8 Ma is our best estimate for the age of the solar system and agrees with Pb-Pb ages reported for CAIs [1,7], indicating that the Hf-W isochron for CAIs dates their formation but not a later event.

The initial ε_W of CAIs is indistinguishable from values for iron meteorites with ^{182}W/^{184}W unaffected by cosmic rays. This indicates that accretion, melting and core formation in the parent bodies of magmatic iron meteorites occurred in less than ~0.5 Myr after formation of CAIs.

[1] Amelin Y. et al. 2002. *Science* 297:1678–1683. [2] Baker J. et al. 2005. *Nature* 436: 1127-1131. [3] Kleine T. et al. 2004. *GCA* 68:2935-2946. [4] Kleine T. et al. 2005. *GCA* 69:5805-5818. [5] Markowski A. et al. 2007. *EPSL, subm.* [6] Amelin Y. 2007 LPSC XXXVIII, 1669. [7] Bouvier A. et al. 2007. *GCA* 71:1583-1604.