

# Pb-Pb geochronology of the early Solar System

A. BOUVIER<sup>1</sup>, J. BLICHERT-TOFT<sup>1</sup>, J. D. VERVOORT<sup>2</sup>,  
W. MCCLELLAND<sup>3</sup> AND F. ALBAREDE<sup>1</sup>

<sup>1</sup>ENS-Lyon, 46 Allée d'Italie, 69364 LYON Cedex 07,  
France (abouvier@ens-lyon.fr)

<sup>2</sup>Washington State University, Pullman 99164, WA, USA  
(vervoort@wsu.edu)

<sup>3</sup>University of Idaho, Moscow 83844, ID, USA  
(wmcclell@uidaho.edu)

We report high-precision Pb isotope data by MC-ICP-MS on whole-rocks and chondrule separates from ordinary chondrites (OC). Compared with literature CAI and mineral separate data [1-3], the ages obtained for OC throw new light on the timescale for the formation and cooling of planetary bodies in the early Solar System.

All age calculations were done in  $^{207}\text{Pb}/^{206}\text{Pb}$ - $^{204}\text{Pb}/^{206}\text{Pb}$  space, which minimizes noise-induced correlations between variables. We then assumed that the sample is a mixture of radiogenic (\*) and common lead and used the intercept of the residue-leachate array in the  $^{207}\text{Pb}/^{206}\text{Pb}$ - $^{204}\text{Pb}/^{206}\text{Pb}$  plot to estimate the  $^{207}\text{Pb}^*/^{206}\text{Pb}^*$  ratios. Full error propagation inclusive of blank contribution (0.01-0.9% of the total Pb contents) required the development of a specific correction scheme. We find that whole-rocks yield ages clearly less reliable than those of chondrules. Chondrules from Ste Marguerite (H4) give an age of  $4563.4 \pm 0.6$  Ma indistinguishable from the phosphate age of  $4562.7 \pm 0.7$  Ma [2]. These values are also indistinguishable from the age of the chondrules from Nadiabondi (H5) ( $4562.5 \pm 0.9$  Ma), whereas the phosphates give a younger age of  $4555.6 \pm 3.4$  Ma [2]. The oldest age is obtained for Forest City (H5),  $4567.8 \pm 0.7$  Ma. The chondrules from Tuxtuac (LL5) are  $4559.9 \pm 0.5$  Ma old, again older than the phosphates ( $4543.6 \pm 2.1$  Ma) [2]. Overall, the ages of L OC are younger than those of H and LL OC. Cooling rates may be estimated using the data of [4] on Pb diffusion in rock-forming minerals: a fast cooling rate ( $\sim 300^\circ\text{C}/\text{My}$ ) is inferred for Ste Marguerite, whereas Nadiabondi ( $\sim 40^\circ\text{C}/\text{My}$ ) and Ausson (L5;  $10^\circ\text{C}/\text{My}$ ) appear to have cooled much more slowly. The age of Ste Marguerite is therefore the closest to the temperature peak. Assuming that the dominant heat source was  $^{60}\text{Fe}$  ( $T_{1/2} = 1.5$  My), this places the age of the protoplanet at  $4567 \pm 1$  Ma, which is similar to the age of the CAI of [1].

## References

- [1] Amelin et al. (2002) *Science* 297, 1678-1683 [2] Göpel et al. (1994) *EPSL* 121, 153-171 [3] Amelin (2000) *LPSC* 1201 [4] Cherniak et al. (1991) *GCA* 55, 1663-1673.