The shocking state of baddeleyite in basaltic shergottite NWA 5298

J.R. DARLING[1]*, D. E. MOSER[2], I. BARKER[2], K.T. TAIT[3], K. CHAMBERLAIN[4] AND A.K. SCHMITT[5]

[1]University of Portsmouth, UK (*darling@port.ac.uk)
[2]Univ. of Western Ontario, London, Ontario, CAN
[3]Royal Ontario Museum, Toronto, Ontario, CAN
[4]University of Wyoming, Laramie, Wyoming, USA
[3]UCLA, Los Angeles, USA

Meteorites from Mars offer unique insights into the age and evolution of the planet's crust. In order to fully understand this precious archive, it is critical to separate the effects of shock metamorphism that occurs during ejection from endogenic crustal processes.

Here we show that in the case of the highly shocked shergottite NWA 5298, this evolution can be resolved by combining electron beam microstructural techniques (CL, EBSD) with in-situ U-Pb SIMS analyses. We focus upon the effects of shock metamorphism on the U-Pb systematics of baddeleyite (ZrO_2) – a mircon-scale phase common to many shergottites. Unlike zircon, the relationship of shock heating and deformation with retention of radiogenic Pb is poorly known.

Baddeleyite grains from a single polished thin section show a wide array of deformation microstructures. These include fracturing, varying degrees of amorphization and granulation, plastic deformation, and recrystallization due to post-shock fluids: reflecting local variations in shock pressures and waste heat. SIMS U-Pb isotope analyses of these grains reveal variable degrees of age resetting, broadly correlated with microstructure and preservation of primary igneous CL zonation. Of the 19 analysed grains, four of the oldest six U-Pb dates are from grains which exhibit oscillatory growth banding. Degree of Pb loss (as much as 80%) is also broadly correlated with degree of growth of post-shock zircon reaction rims. The zircon reaction rims are linked to release of Si-rich fluids during quenching of shock melt pockets during transit to space. These findings, contrary to the results of shock loading experiments [1], indicate that baddeleyite U-Pb ages can be reset under certain shock metamorphic pathways. The U-Pb data are thus useful for determining both the primary age of the meteorite assemblage and bracketing the time of its Earthward launch.

[1] Niihara *et al*.., (2012) EPSL, 341-344, 195-210

Interstellar and interplanetary solids in the laboratory

E. DARTOIS[1,2]*

[1]CNRS-INSU, Institut d'Astrophysique Spatiale, UMR 8617, 91405 Orsay, France (*correspondence: emmanuel.dartois@ias.u-psud.fr)
[2]Université Paris Sud, Institut d'Astrophysique Spatiale, UMR 8617, bât 121, 91405 Orsay, France

The interstellar medium is a physico-chemical laboratory where extremes conditions are encountered, and whose environmental parameters (e.g. density, reactant nature, radiations, temperature, time scales) define the composition of matter.

Whereas cosmochemists can spectroscopically examine collected extraterrestrial material in the laboratory [e.g. 1,2,3,4,5,6], astrochemists must rely on remote observations to monitor and analyze the physico-chemical composition of interstellar solids [e.g. 7,8,9,10,11].

The observations give essentially access to the molecular functionality of these solids, rarely elemental composition constraints and isotopic fractionation only in the gas phase. Astrochemists bring additional information from the study of analogs produced in the laboratory, placed in simulated space environments.

In this presentation I will briefly touch some observations of the diffuse interstellar medium (DISM) and molecular clouds (MC), setting constraints on the composition of organic solids and large molecules in the cycling of matter in the Galaxy and try to draw some commonalities and differences between materials found in the Solar System and Interstellar dust.

[1] Orthous-Daunay *et al*.. (2013) Icarus 223, 534–543. [2] Dartois *et al*.. (2013) 224, 243–252. [3] Brunetto *et al*.. (2011) Icarus 212, 896–910. [4] Kebukawa *et al*.. (2011) Geochim. Cosmochim. Acta 75, 3530–3541. [5] Sandford *et al*.. (2006) Science 314, 1720–1724. [6] Flynn *et al*.. (2003) Geochim. Cosmochim. Acta 67, 4791–4806. [7] Spoon *et al*.. (2007) The Astrophysical Journal 654, L49-L52 [8] Dartois & Muñoz Caro (2007) Astronomy and Astrophysics 476, 1235-1242 [9] Van Diedenhoven *et al*.. (2004) The Astrophysical Journal 611, 928-939. [10] Chiar *et al*.. (2002) The Astrophysical Journal 570, 198-209. [11] Pendleton *et al*.. (1994) The Astrophysical Journal 437, 683-696.

www.minersoc.org
DOI: 10.1180/minmag.2013.077.5.4