

## Isotopic and Elemental Evidence of Magma Ocean Processes Recorded in Early Archean Komatiites

IGOR S. PUCHTEL<sup>1</sup>, RICHARD J. WALKER<sup>1</sup>,  
MATHIEU TOUBOUL<sup>1</sup> AND JANNE BLICHERT-TOFT<sup>2</sup>

<sup>1</sup>Dept. of Geology, Univ. of Maryland, College Park, MD  
20742, USA (correspondence: ipuchtel@umd.edu)

<sup>2</sup>Ecole Normale Supérieure de Lyon, 69007 Lyon, France

Isotopic and elemental data for well-characterized Archean komatiite systems from around the globe provide critical new insights into early-Earth processes. Combined new <sup>142,143</sup>Nd, <sup>182</sup>W, <sup>176</sup>Hf, and <sup>186,187</sup>Os isotopic data for early Archean komatiite systems are consistent with formation, followed by long-term isolation, of deep-seated mantle domains with fractionated time-integrated Sm/Nd, Hf/W, Lu/Hf, and Pt/Os ratios at ca. 4400 Ma. These domains were likely generated as a result of crystallization of a primordial magma ocean, with Mg-perovskite, Ca-perovskite, and Fe-Pt alloy acting as the fractionating phases [1]. The inferred mantle domains were largely mixed away by 2.7 Ga on the scale of mantle reservoirs sampled by late Archean komatiite lavas emplaced worldwide, as evidenced by uniform time-integrated Sm/Nd, Lu/Hf, Re/Os, and Pt/Os ratios in late Archean komatiite systems. The total HSE abundances present in the sources of early Archean komatiite systems, corrected for the inferred Pt fractionation during crystallization of the terrestrial magma ocean, are 70-75% of those in estimates of the modern PM, and are within the range of the total HSE abundances present in the sources of late Archean komatiite systems, indicating little change in HSE abundances in the Archean mantle between 3.5 and 2.7 Ga.

Higher Pt abundances in late Archean komatiites compared to their early Archean counterparts have been taken as evidence for sluggish, downward mixing of late accreted material into the mantle [2]. Our <sup>142,143</sup>Nd, <sup>182</sup>W, <sup>176</sup>Hf, and <sup>186,187</sup>Os isotopic and HSE abundance data for early Archean komatiite systems are inconsistent with such a scenario; instead, our data require that late accretion of HSE to Earth was largely complete by the time the terrestrial magma ocean had crystallized. Rather than downward mixing of an HSE-rich late veneer, the Pt concentration variations observed in Archean komatiites [2] may reflect sluggish mixing of diverse post-magma ocean domains characterized by variably fractionated HSE abundances.

[1] Puchtel I.S. *et al* (2013) *GCA* 108, 63-90. [2] Maier W.D. *et al* (2009) *Nature* 460, 620-623.

## Chemical reactions of hydrogen in depleted gas reservoirs – a major research topic of the H<sub>2</sub>STORE project

D. PUDLO<sup>1</sup>, S. HENKEL<sup>1</sup>, R. GAUPP<sup>1</sup> AND THE H<sub>2</sub>STORE TEAM<sup>2</sup>

<sup>1</sup>Friedrich-Schiller-University Jena, Institute of Geosciences,  
Burgweg 11, D-07749 Jena, Germany (\*correspondence:  
dieter.pudlo@uni-jena.de)

<sup>2</sup>German Research Centre for Geosciences, Potsdam (GFZ) &  
Clausthal University of Technology & Centre National de  
la Recherche Scientifique, Université de Lorraine

The collaborative project H<sub>2</sub>STORE (= Hydrogen to Store) investigates the feasibility of hydrogen underground storage in porous sandstones. Thereby a special emphasis is given to depleted gas reservoirs and gas storage sites, which commonly are comprised of reservoir sandstone layers and sealing mudstone cap rocks.

The most fundamental study on interaction of hydrogen with reservoir sandstones was given by Foh *et al* [1]. However there, only specific single mineral behaviour with hydrogen were regarded not taking into account the chance of complex interactions with further reservoir compounds. The complexity of potential reactions of hydrogen within depleted gas reservoirs arises from (a) reactions of hydrogen with the total mineral assemblage and thereby generated most variable reaction components, which might react quite different, than assumed monomineralic systems, (b) reactions with (commonly) high saline formation water, present in the pore space of the reservoir sandstones, (c) reactions with the residual remnants (e.g. crude oil, bitumen) of the HC-sites, and (d) reactions with microbiological organisms (e.g. bacteria) present at depths.

Thus, reactions in depleted gas/oil reservoirs and hydrogen are highly complex and asks for detailed investigations.

In the H<sub>2</sub>STORE project several kinds of laboratory experiments at reservoir conditions and numerical simulation approaches are planned to investigate reactions given above. The relevance of these regards for hydrogen underground storage in porous media is that by these mineralogical, geo-, hydro-, and biochemical interactions the reservoir quality (e.g. porosity, permeability) can be strongly affected and an impact on the recharge rate for injected hydrogen and on the potential of green methane ("power-to-gas") production is most reasonable.

[1] Foh *et al* (1979) *Underground hydrogen storage. Final report. Brookhaven National Laboratory, p. 145.*