John Wheeler – Senior Bursary 2011

A Senior Bursary from the Mineralogical Society enabled me to attend, for the first time, a Goldschmidt conference – in Prague, 2011. With research interests in structural and metamorphic geology, the Goldschmidt was not a standard venue for me and it proved enlightening. There were four reasons to attend.

First, together with Rainar Abart and Bjorn Jamtveit I was co-convening a session on "Interplay between Plastic Rock Deformation and Mineral Reactions" **(20c)**: our aim here was to showcase the overlaps between the chemical processes of reaction and the physical processes of deformation. This is a long-standing interest of mine and there is still fundamental science to be done in this area, as the talks showed. We've known for decades from observations in shear zones that deformation and metamorphism feedback on each other, but some of the basic processes operating in shear zones and other settings remain to be unraveled.

Secondly, my PhD student John MacDonald and I had chosen it as a venue in which to present his work on zircon dating in the Lewisian Complex of NW Scotland. My own research has involved structural and metamorphic evolution of this region, and in the last two decades zircon dates have been interpreted to give a rather different, and arguably incompatible, story. So, working with Kathryn Goodenough, Quentin Crowley, Simon Harley and Elisabetta Mariani, we set out to explore how deformation might influence zircon chemistry and geochronology, on all scales from intracrystalline to large shear zones. Along the way we've gathered evidence that the Lewisian was hot for a very long time in the Archaean, hence "Combined SIMS U-Pb ages and Ti-in-zircon

geothermometry fingerprints long deep crustal residence in the Archaean". By the time of presentation, we were cautious about the meaning of the Ti data, but our conclusion could be defended in other ways. With the large number of zircon experts and zircon geochemistry presentations at the Goldschmidt, this was a great opportunity to gather feedback on our ideas and to gain further insights into the behaviour of zircon.

Thirdly, I wanted to present some of my own work on fundamental links between stress and metamorphism, echoing in a "Frontiers" theme my interests in session 20c - "Fluid pressure versus rock pressure: Their influence on metamorphic reactions". Anyone reading this will know that metamorphic processes are described in terms of pressure and temperature effects, hence the ubiquitous use of "PT grids". But what happens when fluid and rock pressures are different? This is commonly the case for porous rocks in the Earth but there's no coherent picture for how reactions proceed under such circumstances. I presented a conceptual mode, together with experimental results (work with Sergio Llana-Funez and Dan Faulkner), and there was plenty of feedback afterwards.

And the fourth reason? To expand my horizons – to see what is happening outside my discipline. For example, the plenary talk of Hirschmann asked a deceptively simple question: why is the H/C ratio of the mantle different from that of the exosphere? Well, I'd never thought about that – but by the end of the talk I could see how many Earth process must be invoked to address that question, and how it impacts on our understanding of those processes. This seemed to me an example of geochemistry in action at its best.