

**Manchester Geological Association**  
**South Theatre (SG1), Samuel Alexander Building,**  
**University of Manchester**  
**Saturday 6th December 2014 at 1.30pm**

**Ophiolite Suites**

- 13.30 – 14.15 Ophiolites and Accretion Models for the Oceanic Crust  
Dr Johan Lissenberg, University of Cardiff
- 14.15 – 15.00 Memories of Ocean Basin Opening and Closing preserved in Ophiolite Peridotites?  
Dr Brian O'Driscoll, University of Manchester
- 15.00 – 15.30 Comfort Break (Drinks may be obtained from drinks-machines)
- 15.30 – 16.15 Why the Oman Ophiolite did not form at a Mid-Ocean Ridge  
Professor Hugh Rollinson, University of Derby

**Ophiolites and Accretion Models for the Oceanic Crust**  
**Dr Johan Lissenberg, University of Cardiff**

Ever since the realisation in the late 1960's that ophiolites represent ancient pieces of oceanic crust and upper mantle they have been instrumental in the development of models for the formation of oceanic crust. Despite the early recognition (at least by some) that ophiolites may actually have formed in a subduction-related setting, they continue to form the basis of mid-ocean ridge crustal accretion models. This is particularly the case for the Oman ophiolite, the largest and best-exposed ophiolite on Earth. Early work led to the concept of a large (several km-size), melt-filled magma chamber that froze along its walls to form the lower oceanic crust. However, geophysical experiments on Pacific Ocean crust in the late 1980's ruled out the existence of large magma chambers, imaging only a lens of 10's of meters thick at the top of the lower crust. This paradox has led to two competing models, both developed in Oman, that are still debated today; the sheeted sill and gabbro glacier models. Work on the Annieopsquotch ophiolite (Newfoundland), recent geophysical observations, and the first comprehensive dataset from in-situ lower oceanic crust from the Pacific Ocean suggest that a significant proportion of crustal accretion occurs by sill intrusion.

**Memories of Ocean Basin Opening and Closing preserved in Ophiolite Peridotites?**  
**Dr Brian O'Driscoll, University of Manchester**

The mantle sections of ophiolites offer a useful approach to studying compositional heterogeneities in the oceanic mantle. A potential caveat is that the tectonic provenance of ophiolites is often not easy to decipher, although many have undergone at least supra-subduction zone (SSZ) processing. Significant outstanding questions include the degree to which ophiolite peridotites preserve evidence of pre-SSZ events and the way that SSZ melt extraction modifies the character of these peridotites. A suite of Caledonian ophiolites associated with the closure of the Iapetus Ocean offers an opportunity to shed light on these

issues, in particular to assess the degree to which long (regional) wavelength compositional heterogeneities survive SSZ melting. Observations on the combined highly-siderophile element (HSE) and  $^{187}\text{Os}/^{188}\text{Os}$  systematics of the broadly coetaneous (490-500 Ma) Shetland Ophiolite Complex (Scotland) and Leka Ophiolite Complex (LOC; Norway) are presented here.

Generally, the lithological composition of each locality is harzburgitic, and hosts lenses and layers of dunite, chromitite and pyroxenite that are interpreted as representing SSZ-related (channelised) melt migration and melt-rock interaction. Although the bulk of the harzburgitic rocks have approximately chondritic initial  $^{187}\text{Os}/^{188}\text{Os}$  and HSE abundances, ancient (Proterozoic) melt depletion (melt extraction ages of 1.4 to 1 Ga) is recorded in ~10% of samples from each locality. This is also commonly observed in abyssal peridotites. One important implication of the data is that SSZ melt generation/migration has had no discernible impact on the bulk Os isotopic composition of the Iapetus oceanic mantle. By contrast, non-harzburgitic lithologies consistently exhibit more radiogenic initial  $^{187}\text{Os}/^{188}\text{Os}$  and more variable HSE abundances. The dunites, chromitites and pyroxenites of the LOC can be separated into two groups on the basis of errorochrons that they define; yielding ages of  $481\pm 22$  Ma and  $589\pm 15$  Ma, respectively. The former age corresponds, within error, to the accepted age of the ophiolite ( $497 \pm 2$  Ma). The meaning of the latter age is uncertain, but may correspond to the early stages of Iapetus opening. The data imply that the oceanic mantle represented by both ophiolites resembles a 'patchwork' of peridotites of different ages and compositions.

### **Why the Oman Ophiolite did not form at a Mid-Ocean Ridge** **Professor Hugh Rollinson, University of Derby**

The Oman ophiolite is one of the largest, best exposed slices of ocean crust preserved anywhere in the world. It has been the subject of intensive field, geophysical and geochemical investigations for over 30 years with work by major groups from the USGS, University of Montpellier in France, the Open University and Cardiff University in the UK, and more recently groups from Japan and Germany. For many years the prevailing view has been that the Oman ophiolite formed at a fast spreading mid-ocean ridge analogous to the East Pacific Rise. Dissenting voices have sought to be heard, for since the 1980's there has been published geochemical evidence to show that this famous example of sea-floor spreading formed, at least in part, in an arc setting. In the last decade there has been a muddle of compromise views in which this suite of rocks could have formed in more than one tectonic setting. However, recently a consensus has emerged which strongly suggests that the Oman ophiolite formed in the forearc segment of a newly formed arc, through the process of subduction initiation.

This talk will review recent geochemical evidence to show that basaltic lavas, thought to have formed in a mid-ocean ridge environment, have in fact formed in a more hydrous environment, which is probably closely associated with subduction. A particular focus will be chromite deposits located in the Oman mantle formed from basaltic melts, thought originally to be of mid-ocean ridge origin. New geochemical evidence from granitic melts enclosed in mantle rocks strongly suggests that these are melts of former sediments. How melted sediments might be emplaced into the mantle is a huge geological puzzle. The solution currently under consideration is that they are subduction zone melts emplaced into a mantle wedge, further confirming a subduction setting for the Oman ophiolite.