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Deformation-enhanced fluid flow in rocks

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THE Metamorphic Studies Group is affiliated to both the Mineralogical Society and the Geological Society of London. Following the lead of the President of the Geological Society, Prof. Stephen Sparks, who advocated greater integration of the various groups of the Society, the Metamorphic Studies Group committee decided that the September 1995 meeting would be an interdisciplinary effort, involving both thc Volcanic and the Tectonics Study Groups. This was particularly apposite as the subject in question, the effects of deformation in rock permeability, has been of great interest of late to geologists working in all fluid-bearing environments of the Earth.

The scope of the meeting was kept as broad as possible, with sessions ranging from the movement of basaltic melt in the mantle, through the segregation, ascent and emplacement of granitic melts, to the movement of volatile fluids in the crust during both ductile and brittle deformation. Over three days, six invited talks were presented, along with 27 offered talks. 17 posters were displayed throughout the duration of the conference. The seventh invited speaker, Prof. Harry Green, unfortunately managed to miss his plane from Los Angeles, but with 24 hours notice Prof. Ian Parsons, of the University of Edinburgh, regaled the audience of 70 (from all over Europe, North America, and the former Soviet Union) with a slide show of feldspathology. Twelve invited contributions from the conference will appear in volume 9 of the Mineralogical Society Chapman & Hall Special Series, and five additional papers were accepted for publication in the Mineralogical Magazine and comprise the thematic set which follows this introduction.

The first of the set, by **Oliver and Barr**, presents field observations of deformation-assisted melt migration in migmatites from the Halls Creek Orogen in Western Australia, which can be used to constrain melt flow pathways and migration distances. Melt migration in metasedimentary migmatites and adjacent metabasites occurred along separate and non-interconnected fracture networks. In the metasedimentary part of the sequence, small extensional fractures and shear zones filled with locally-derived melt cut stromatic leucosomes. Adjacent metabasic units have been injected by externally derived mafic to ultramafic melts, which are inferred to have migrated along the layers. Another attempt to determine melt migration pathways is made by **Cesare, Salvioli and Venturelli**, who examine the grain-scale distribution of rhyolitic anatectic glass in metapelitic xenoliths caught up in the dacitic lava of El Joyazo, Southeast Spain. They conclude that melt extraction from the metapelitic source was assisted by deformation during syn-anatectic foliation development, with migration of melt occurring along the foliation planes.

Ayres, Harris and Vance show that accessory mineral dissolution rates can be used to put constraints on the timescale of melt segregation. The concentrations of light rare earth elements and zirconium in a melt in chemical equilibrium with its source will be buffered by the phases monazite and zircon respectively. If melt segregation is faster than the rate of diffusional homogenization the melt will be undersaturated with respect to these elements.

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They show that the observed composition of tourmaline leucogranites from Zanskar in Northwest India is consistent with rapid extraction on timescales of less than 50,000 years. Further work on Himalayan granites is presented by **Butler, Harris and Whittington**, who examine the interactions between deformation, magmatism and hydrothermal activity in the Nanga Parbat massif. They find that deep infiltration of minor amounts of hydrous fluids in shear zones results in localised anatexis at depths of 15km. Higher in the massif, infiltration of meteoric fluid is more marked, resulting in a positive feedback mechanism between fluid flow and deformation which channelizes flow of both hydrous and magmatic fluids into active structures.

A novel approach to the formation of fibrous veins is provided by **Bons and Jessell**, who performed an elegant set of experiments creating fibrous crystals of soluble salts in an imposed chemical potential gradient. They demonstrate that fibrous vein formation does not necessitate repeated fracturing and fluid flow (the crack-seal mechanism), but may occur as a consequence of localized precipitation during diffusional mass transfer.