The petrology of kimberlites in South Australia

R. TAPPERT[1]*, J. FODEN[1] AND K. WILLS[2]

[1]Department of Earth and Environmental Sciences, University of Adelaide, Adelaide, South Australia
(*correspondence: ralf.tappert@adelaide.edu.au)
[2]Flinders Mines Ltd., Norwood, South Australia

The South Australian Kimberlite Province

Within the South Australian kimberlite province, most kimberlites have been discovered in the Adelaide Fold Belt, where they occur as a semi-continuous dyke swarm of Jurassic age. These kimberlites include the diamondiferous kimberlites of the Eurelia area [1,2].

Here we present compositional and petrographic data for kimberlitic minerals from 35 kimberlites from the South Australian kimberlite province, most of which are newly discovered. The composition of groundmass minerals, particularly spinel and phlogopite, shows discrete regional variations. For example, kimberlites from the Eurelia area, in the north-western part of the Adelaide Fold Belt, and kimberlites from the Monks Hill area, in its eastern part, contain groundmass spinels and phlogopites with overall high Mg-numbers (Mg/Mg+Fe^{2+}) and low titanium contents. In contrast, spinels and phlogopites from kimberlites in the central and southern part of the Adelaide Fold Belt kimberlite field, around Peterborough and Terowie, are more enriched in iron and titanium.

Petrographically Eurelia kimberlites are distinguishable from other kimberlites in the South Australian kimberlite province by their generally low abundance of groundmass phlogopite, which is typical for Group I kimberlites. The more micaceous kimberlite varieties in South Australia, particularly in the eastern part of the Adelaide Fold Belt, which are more Group II like, may represent a separate kimberlite generation.

Discussion

The apparent compositional and petrographic differences of the kimberlites in South Australia probably reflect variations in the composition of the underlying lithospheric mantle. The more enriched character of the groundmass minerals in the central kimberlites may be a reflection of enrichment processes during the Proterozoic rift-stage of the Adelaide Fold Belt.

[1] Scott Smith *et al.* (1984) *in* Kornprobst, J.: *Kimberlites and related rocks.* [2] Tappert *et al.* (2009) *Geology* **37(1)**, 43-46.

Modification of fluid inclusions by experimental plastic deformation of natural single quartz

A. TARANTOLA[1]*, L.W. DIAMOND[1] AND H. STÜNITZ[3]

[1]Rock-Water Interaction Group, University of Bern, Baltzerstr. 3, CH-3012 Bern
(*correspondence: alexandre.tarantola@geo.unibe.ch)
[3]Institute of Geology, University of Tromsoe, 201 Dramsveien, N-9037 Tromsoe

The interpretation of natural inclusions in plastically deformed minerals has been problematic for many years. Although modifications of shape, density and sometimes composition have been suspected, no reliable criteria are available to interpret the significance of the modified inclusions for reconstructions of paleo-fluid properties. In order to better understand the mechanisms of the modifications and to determine to what extent fluid inclusions in such contexts can be used for paleo-fluid analysis, low strain experiments were conducted on natural, single crystals of quartz containing CO_2-H_2O-NaCl fluid inclusions.

In a first step, hydrostatic experiments were conducted to define the *PT* conditions under which the inclusions experienced no differential pressure ($P_{internal} = P_{confining}$). Our observations showed that, at T = 700°C and P = 600 MPa, the inclusions adopted negative-crystal shapes and that the original microthermometric values (T_m(cla) and T_h(car)) remained the same.

Axial compression experiments were then performed at these *P*–*T* conditions using a Griggs piston-cylinder apparatus. After the experiments (all with less than 5% strain), the original fluid inclusions are surrounded by planar haloes of newly-formed inclusions. The orientation of these planes is dictated by the crystallography of the host quartz. With increasing deviatoric stress the density of the relict inclusions systematically decreases, whereas the density of the new satellite inclusions systematically increases, and is always higher than that of the original inclusions.

In our compression experiments, the fluid inclusions became flattened and elongated along the crystallographic plane of quartz closest to the least compressive stress σ_3. The decrease in density of the original inclusions is attributed to an increase in volume via micro-cracking. The new satellite inclusions represent the fluid density appropriate to the maximum principle stress σ_1.

The textures of the fluid inclusions and of the quartz crystals in our experiments are similar to those found in plastically deformed quartz in nature. The experimental results therefore offer a framework in which to interpret the significance of natural fluid inclusion assemblages.