Seismic anti-correlation in the mantle: Is hot blue and cold invisible?

A.S. PIAZZONI[1], G. STEINLE-NEUMANN[2] AND H.-P. BUNGE[3]

[1]Department for Geosciences, University of Munich, Germany (antonio.piazzoni@geophysik.uni-muenchen.de)
[2]Bayerisches Geoinstitut, University of Bayreuth, Germany (g.steinle-neumann@uni-bayreuth.de)
[3]Department for Geosciences, University of Munich, Germany (bunge@geophysik.uni-muenchen.de)

Low levels of bulk sound velocity (VΦ) variations below 2000 km depth in the mantle and a prominent anti-correlation of VΦ to shear seismic wave velocity (VS) near the core mantle boundary are typically used to infer the presence of compositional deep mantle heterogeneity. Using a thermodynamically self-consistent mantle mineralogy model based on Gibbs free energy minimization we show that these effects can arise from differences in the isothermal and adiabatic bulk modulus at high pressure and temperature of the Earth's lower mantle, and that it is possible to reproduce the observed VS/VΦ anti-correlation in a chemically uniform mantle. The mineralogy model provides us with elastic constants and density for any given P,T condition.

We take this density to compute convective buoyancy forces in a simple (2-D purely bottom heated isoviscous and isochemical) compressible mantle convection model. Our approach allows us to predict a number of seismic observables from the convection model, all of which agree remarkably well with observations from a tomographic study. Our results are fully compatible with other published mantle mineralogy models, which similar to our finding predict an increase of $\partial V\Phi/\partial T$ with temperature and pressure, and a pronounced VS/VΦ anti-correlation in the lowermost mantle.

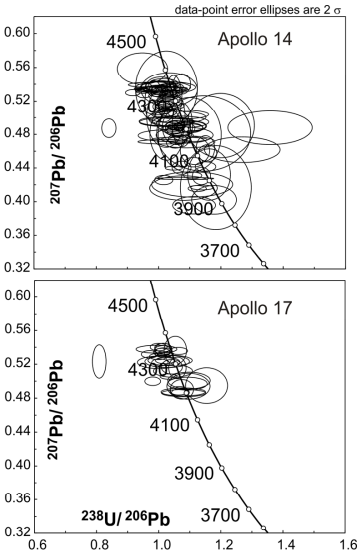
Contracting KREEP magmatism in the early evolution of the Moon

R.T. PIDGEON[1], A.A. NEMCHIN[1], J. VAUGHAN[1] AND M.J. WHITEHOUSE[2]

[1]Curtin University of Technology, Perth, Western Australia (a.nemchin@curtin.edu.au, r.pidgeon@curtin.edu.au, j.vaughan@curtin.edu.au)
[2]Swedish Museum of natural History, Stockholm, Sweden (martin.whitehouse@nrm.se)

Ages of zircons from lunar Breccias

Previous (SHRIMP) age studies of zircons from lunar granophyres and other rocks (Meyer *et al*. 1996) showed that zircon-forming magmatism in the lunar highlands was continuous from 4.3Ga until at least 3.88Ga. We have further investigated the distribution of lunar zircon ages by undertaking SIMS U-Pb isotopic analyses (SHRIMP II at Curtin University and CAMECA 1270 at the Swedish Museum) of zircons from breccias from the Apollo 14 and Apollo 17 landing sites.



U-Pb results

Analytical results, presented on concordia plots on Figure 1, show that Apollo 14 and 17 zircons have essentially identical age patterns in the range 4.35 to 4.20Ga, but, whereas Apollo 14 zircons have ages in the range 4.20 to 3.9 Ga, zircons from Apollo 17 samples have no ages younger than 4.20Ga.

Interpretation

Our results show that lunar zircon-forming magamtism was not continuous from 4.35 to 3.88Ga everywhere on the Moon, but has a marked regional asymmetry. We explain this by proposing that between about 4.35 and about 4.20Ga the source reservior for zircon-forming KREEP magmatism contracted to only just include the area of the Serenitatus impact (Apollo 17) and after about 4.20Ga no zircon-forming magmatism occurred at this site. Magmatism continued at a reducing rate at the Apollo 14 site until about 3.90Ga, when it also ceased.

Reference

Meyer C., Williams I.S. and Compston W. (1996) *Meteorit. Planet. Sci*. **31**, 370-387.