Rutile and zircon thermometry in sedimentary provenance studies

SILKE TRIEBOLD[1], THOMAS ZACK[2], ANDREAS KRONZ[3] AND HILMAR VON EYNATTEN[1]

[1]Geowissenschaftliches Zentrum Göttingen, Abteilung für Sedimentologie, Goldschmidtstr. 3, 37077 Göttingen, Germany (striebo@gwdg.de)
[2]Mineralogisches Institut, Universität Heidelberg, Im Neuenheimer Feld 236, 69120 Heidelberg, Germany
[3]Geowissenschaftliches Zentrum Göttingen, Abteilung für Geochemie, Goldschmidtstr. 1, 37077 Göttingen, Germany

Due to their high physical as well as chemical stability and widespread occurrence in many rock types, both rutile and zircon are preferred candidates in single-mineral provenance analysis.

In order to compare thermometry results from both mineral types, a total of 62 sand samples from local creeks (small catchment areas <10km^3) were collected in the eastern Erzbgebirge. The exposed rocks range up to more than 2.9GPa and 850°C in formation conditions, as found by conventional thermobarometry.

Rutile and zircon separates of samples from various metamorphic conditions were extracted and analysed by electron microprobe and secondary ion mass spectrometry. Zr-in-rutile- and Ti-in-zircon thermometers were applied.

The results show that maximum temperatures as well as temperature distributions obtained by the two methods from the same samples differ. While rutile exhibits homogenous internal Zr-distributions, zircon is often chemically zoned and cores and mantles record substantially different temperatures.

This gives us the opportunity not only to derive temperature information on the last metamorphic cycle the sediments' source rocks were exposed to, but also on earlier metamorphic events. Dating of the analysed rutiles and zircons provides additional data highly valuable for a reconstruction of the sediments' history.

Timing of protoplanetary disc dissipation and planetesimal formation in the early solar nebula

M. TRIELOFF

Mineralogisches Institut Universität Heidelberg, Heidelberg, Germany (trieloff@min.uni-heidelberg.de)

The lifetimes of protoplanetary disks of 3-6 Ma [1] around young stars constrain the time scales of planetesimal formation. Most studies suggest that formation of asteroid-sized planetesimals in the early solar system occurred within a few Ma [e.g. 2-4], indicating that the building blocks of terrestrial planets were already present when the disk was dissipated. However, it is not yet clear, if full-sized terrestrial planets accreted within the presence of disk gas or not. While for the outer gas or ice giant planets rapid accretion and attraction of disk gas as major constituent is mandatory, the terrestrial planets obviously needed significantly longer time for complete accretion, as indicated by Hf-W ages of complete core formation of 10 Ma for Mars and 33 Ma for Earth [5]. The question if terrestrial planets accreted with the presence of gas or after disk dissipation can be answered using neon isotopes [6-10], particularly utilizing advances in high precision neon isotope measurements in recent years [11-14]. These results provide increasing evidence that Earth´s precursor planetesimals acquired solar neon as solar wind-implanted ions ("Ne-B"), similar to carbonaceous chondrite [15] or Rumuruti parent bodies. For the latter, thermochronological modelling [16-18] suggests very early brecciation and irradiation. Several irradiation scenarios are possible: 1) irradiation before disk gas dispersal, due to planetesimal orbits with high inclinations (possibly triggered by gravitational disturbations of Jupiter) 2) late accretion of fine, irradiated dust to Earth, e.g. after the moon forming impact 3) disk gas dissipation 3-4 Ma after CAIs in the inner solar system, possibly triggered by photoevaporation of the disk.

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