Microstructural characteristics of rutile in in diamondiferous gneisses of the Saxonian Erzgebirge, Germany

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A high pressure polymorph of TiO_2, still unnamed and with the structure of α-PbO_2, has been recently reported to occur in ultra high pressure metamorphic (UHP) rocks. The presence of this phase allows to constrain the peak pressures prevailing during UHP. One such example are the diamondiferous gneisses of the Saxonian Erzgebirge, Germany, which contain nano-sized relicts of α – PbO_2 type TiO_2, indicating a pressure of 5 GPa. This corresponds to a former depth of at least 130 km. [Hwang et al (2000)]. However, there is still a controversy on the stability fields of the various polymorphs in the TiO_2 system [Olsen et al (1999), Akaogi et al (1992), Withers at al (2003)]. These discrepancies might be due to sluggish kinetics of the phase transformation and / or the effect of trace elements such as H, Si, Fe, Nb, Zr or Hf, which are known to influence the stability fields of the different TiO_2 polymorphs. [Bromiley et al (2004)]
In order to gain more insight into the transformation and deformation of TiO_2 phases under UHP conditions, we have studied rutile inclusions in both garnet and the matrix from UHP gneisses of the Saxonian Erzgebirge, using optical microscopy, Raman spectroscopy, EMPA, SEM and TEM. EDX analyses reveal trace amounts of Si, Al and Zr in rutile. The substitution of Ti by Si is known to occur at high pressures [Ren et al (2005)], whereas the presence of Zr is related to high temperature [Watson et al (2006]. However, in contrast to [Hwang et al (2000)], we cannot confirm the presence of α – PbO_2 type TiO_2 by TEM. Instead, the microstructure of the rutile grains consists of numerous dislocations in glide configuration and lamellar ilmenite exolutions. Since the solubility of the ilmenite component in rutile is not callibrated so far, we infer a minimum pressure of 4 GPa, based on the observation of diamond.

References

Akaogi M, Kusaba K et al. (1992) High-pressure high-temperature stability of -PbO_2-type TiO_2 and $MgSiO_3$ majorite, TERRAPUB American Geophysical Union, Washington, DC, pp 447–455.
Bromiley GD, Hilaret N, McCammon C (2004) H^+ and Fe^{3+} solubility in rutile and TiO_2(II): Effects on phase stability, and the role of silica polymorphs in the lower mantle, Geo. Cos. Acta 68: A37-A37.
Hwang SL, Shen P, Chu HT, Yui TF (2000) Nanometer-Size -PbO_2-Type TiO_2 in Garnet: A Thermobarometer for Ultrahigh-Pressure Metamorphism, Science 288: 321-324.
Olsen JS, Gerward L, Jiang JZ (1999) On the rutile/ -PbO_2-type phase boundary of TiO_2, J Phys Chem Sol 60: 229–233
Ren Y, Fei Y, Yang J, Bai WJ, Xu ZQ (2005) SiO_2 solubility in rutile at high pressure and temperature, American Geophysical Union, Fall Meeting.
Watson EB, Wark DA, Thomas JB (2006) Crystallization thermometers of zircon and rutile, Contrib. Mineral Petrol, 151, 413-433.
Withers AC, Essene EJ, Zhang Y (2003) Rutile/TiO_2II phase equilibria, Contrib Mineral Petrol 145: 199–204.

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