

RADIATION INDUCED DEFECTS IN QUARTZ RESULTING FROM METAMORPHIC PROCESSES

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Rock forming quartz often shows defects due to γ radiation of the rock, mainly resulting from radioactive potassium, uranium, and thorium isotopes. The concentrations of such metastable defects increase with time, they decrease with elevation of temperature. Above a sharp temperature T_c (generally between 40 °C and 150 °C) the defects are annihilated completely. They can be studied precisely using electron paramagnetic resonance (EPR). Important defects in quartz are e.g. substitution of Al, Ti, and/or Ge at Si positions as well as Si or O vacancies. Investigation of samples from drilling profiles or traffic tunnels can provide valuable information about the temperature history of geological bodies. Samples from horizontal traffic tunnels in the Swiss Central Alps as well as vertical drilling profiles in Germany and Russia were studied. Correlated measurements were carried out for γ dose determination of the rock from which the quartz was separated. In addition, Al and Ti contents of quartz were determined using neutron activation. EPR spectra from heat treated samples over different times as well as samples exposed to experimental γ doses in the laboratory were measured for calibration. The EPR spectra reveal typical dependencies on natural γ radiation. Samples from the vertical profiles reveal monotonic decrease of the EPR intensity with increasing depth related to increasing temperature in situ, thus allowing precise determination of T_c . The samples from the horizontal traffic profiles in the Swiss alps reveal complex results related to complex geological history due to regional metamorphism during tertiary mountain formation.