X-RAY AND INFRARED STUDIES OF ZIRCON METAMICTIZATION

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Unit cell dimensions in Ceylon zircons increase with α-dosage and diffraction peaks broaden and weaken (Holland and Gottfried, 1955). IR absorption band intensities (2.5-40μm) show corresponding decreases and polarized spectra (// and ⊥ to the c-axis) show loss of anisotropy with increased α-dosage. Each of the observed structural changes may be used as a quantitative measure of zircon metamictization. For Ceylon zircons having total α-dosages $>4\times10^{15}$ α/mg, x-ray powder patterns show no crystal structure; zircon lattice vibrations in the far infrared are virtually absent; and polarization anisotropy is lost. Intensity of the internal SiO_4^{4-} vibration bands decreases with increasing α-dosage up to $\sim4\times10^{15}$ α/mg where there is an abrupt change in slope. Intensities decrease more slowly at greater α-dosages and the bands continue to broaden (Wasilewski et al, 1973). For the Ceylon zircon suite all crystallographically oriented Zr-O bonds (on which lattice vibrations, anisotropy, and x-ray pattern depend) appear destroyed at a total α-dosage of 4×10^{15} α/mg. Higher α-doses continue to effect the metamict zircon by damaging and distorting the SiO_4^{4-} tetrahedra and their micro-environment.

Studies on this and other suites reveal a wide range in total water and hydroxide content of natural zircons with no apparent correlation between hydration and metamictization. Band positions, width and anisotropy in the O-H stretching region show that both H_2O and OH^- can occur, either together or separately, and that they are crystallographically oriented. Anisotropy in the water region also decreases with increasing α-dosage.