



MINERALOGIC AND ISOTOPIC CONSTRAINTS ON IMPACT RELATED CLAY MINERAL ALTERATION, IN THE WOODLEIGH IMPACT STRUCTURE, WESTERN AUSTRALIA

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Clay mineral fractions from one of the largest Phanerozoic impact structures, the Woodleigh impact structure were investigated by XRD, electron microscopy and K-Ar and stable isotopic studies. Samples were collected from the central uplifted Precambrian basement granitoid, conglomeratic rocks derived from reworked impact rocks, and from the Ordovician-Devonian sandstones located ~30 km west of the central uplift. There are remarkable lateral and vertical variations in authigenic clay mineral compositions and illite crystallinity (IC) values (Kübler index). Clay minerals from shocked granitoid basement rocks are mainly smectite-rich (>75%) mixed-layer illite-smectite with some discrete illite formed as an alteration-product (replacement) of biotite. Clay minerals in the conglomeratic rocks consist of mainly illite and Fe-rich chlorite, and in the lower part of the section, chlorite-rich (>50%) mixed-layer chlorite-smectite. Smectite in the oxidised upper part of the conglomeratic section is probably a weathering-product. Clay minerals from the Ordovician-Devonian sandstones further away from the central part of the impact structure include illite, less chlorite, and in the Devonian strata smectite. IC values of the <2 mm grain-size fraction in the conglomeratic rocks range from 0.51 to 0.56 °Δ2θ in the upper part and from 0.75 to 0.82 °Δ2θ in the lower part of the section. Illites from the Ordovician-Devonian sandstones show significantly higher IC values ranging from 0.75 to 1.45 °Δ2θ. Results of the clay mineralogy suggest that variations of clay mineral compo-

sitions and IC values are related to the changes in rock lithology and the variable effects of impact-induced hydrothermal processes. K-Ar dating of the authigenic illites of the coarser size-fractions (2-1 μm and 0.5-0.2 μm) containing no smectite yield concordant ages around 365 Ma. These K-Ar age data are consistent with previous results (Uysal et al., 2001; EPSL, 192:281–289) and, together with stratigraphic age constraints, confirm that the impact event was coeval with the Late Devonian mass extinction. Woodleigh impact-related clay minerals have significantly high $\delta^{18}\text{O}$ values from 13.4 to 18.9 ppm. The calculated fluid $\delta^{18}\text{O}$ values range from 6.5 to 11.7 ppm that are highly enriched in ^{18}O relative to seawater, meteoric water and most basinal brines and may indicate the hydrothermal fluids interacted with ^{18}O -rich condensed meteoritic components injected into the crater floor.