**Timing of illite authigenesis in Empress-1A, Officer Basin, Western Australia**

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The Geological Survey of Western Australia's (GSWA) vertical diamond drillhole Empress-1A was designed to test the source-rock potential of Neoproterozoic successions within the Yowalga Sub-basin of the western Officer Basin. Results of a detailed combined petrographic and K-Ar dating study, focusing on authigenic illite from Empress-1A, are presented and demonstrate the potential of illite K-Ar geochronology to unravel the timing of diagenetic and thermal processes within this part of the Officer Basin. Petrographic investigations reveal illite within different units as an abundant authigenic mineral phase that causes significant reduction in permeability and porosity. The authigenic illite has a filamentous pore-bridging morphology and crystallinity values are consistent with high-grade diagenesis.

Isotopic and geochemical studies are important tools to understand fluid flow and diagenetic histories, with implications for both exploration and reservoir management. Isotopic age and geochemical tracing data have the potential to yield important information about the origin of hydrocarbons, the timing of fluid flow and related diagenetic events, the nature and distribution of potential formation damage, and the timing of faulting and deformation. Authigenic illite in sandstones contains potassium and is therefore suitable for age determination using the potassium–argon (K/Ar) geochronometer. Diagenetic illite is of interest for the petroleum industry, because it can provide a K-Ar date constraining a heating and/or fluid flow event within a sedimentary basin.

Within this study, 28 K/Ar ages on illite separates (<0.1 to <2–6 μm) from eight sandstone samples, and one basalt K/Ar age were obtained. The illite ages range from 387.89 ± 11.05 Ma (Early Devonian–Emsian) to 1177.18 ± 23.34 Ma (Mesoproterozoic–Stenian) and are clearly depth related, as the ages increase steadily with increasing depth, covering the total well depth of about 1600 m.

The presently limited data do not allow an unequivocal interpretation, but they could indicate post-depositional thermal pulses and/or diagenetic events, in particular around the 380 Ma Alice Spring Orogeny, the 550 Ma Petermann Ranges Orogeny, as well as the older 680–690 Ma Areyonga Movement event.

Future efforts to resolve the ambiguities inherent in the dating of authigenic clays will address both contaminants and possible heterogeneity in the illite population itself. Application of recently developed, *in situ* UVLAMP $^{40}Ar$-$^{39}Ar$ dating and micro-encapsulation, will allow quantification of the effects of heterogeneity. The combination of new technologies will permit more geologic significance to be attached to the results of future isotopic studies of authigenic clay minerals from central and Western Australia.