Late Jurassic–Early Cretaceous sand supply in the Scotian Basin, Canada: insights from Pb isotopic fingerprints

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Late Jurassic–Early Cretaceous deltaic sandstones are important oil and gas reservoirs in the Scotian Basin, offshore Nova Scotia. These sandstones were deposited in response to, and thus cryptically record, the evolution of the North Atlantic rift and associated changes in palaeodrainage along the Canadian passive margin. Determining the provenance of these deltaic sandstones, therefore, not only helps to constrain the timing and location of uplift but also enables us to assess the footprint and relative contribution of individual drainage systems and gain insights into potential reservoir quality since source rock composition asserts a primary control on reservoir quality.

Previous provenance studies using geochemical (both bulk and heavy mineral varietal studies), geochronological (zircon, muscovite, monazite) and petrographic analysis of Jurassic–Cretaceous sandstones have been hampered by widespread polycyclic reworking. The current study builds upon this work by fingerprinting Pb isotopes in detrital feldspar, which record first-cycle supply. The study demonstrates the importance of coupling individual tracers of varying resilience to unravel sedimentary provenance. This study also assesses the utility of the Pb in feldspar approach, including the application of Pb isotopes in detrital plagioclase and diagenetically altered (albitised) grains observed at depths below 2 km. The study uses mostly core samples from over ten wells across the basin, from Mohawk B-93 in the west to Bandol No.1 in the east.

Characterisation of detrital feldspar Pb isotopic compositions clearly demonstrates changes in supply linked with regional topographic variations as a result of the evolving Labrador Rift. A sharp change in the Late Jurassic from Appalachian to Grenville signatures is recorded across the basin but does not mask locally important contributions from proximal sources, particularly in the west of the basin. In the central Sable and eastern Abenaki depocentres, more long-distance sourcing from older Grenvillian rocks to the north is indicated by a single Pb population, raising questions about the independent roles of the proposed paleo-Sable and paleo-Banquereau rivers.

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