SHRIMP constraints on sediment provenance and transport history in the Mesozoic Statfjord Formation, North Sea

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ABSTRACT

Detrital zircons in sandstones of the Statfjord Formation (late Triassic-early Jurassic) in the northern North Sea have been dated with the SHRIMP ion microprobe. These sandstones lack detailed biostratigraphic control, but display distinct variations in heavy mineral assemblages which facilitate a three-fold subdivision of the sequence. The lower and middle zones (heavy mineral Zones A and B) have similar characteristics, both displaying a marked upward decline in garnet abundance which has proved difficult to attribute unambiguously to change in either provenance or sedimentation history. The base of the highest zone (heavy mineral Zone C) is marked by changes in several heavy mineral indicators attributable to a shift in ultimate provenance compared with the underlying zones.

The detrital zircon ages are a direct fingerprint of the sediment source terrains, and so resolve ambiguities in interpreting provenance from heavy mineral abundances alone. The age spectra indicate that both low-garnet and high-garnet parts of Zone A have the same ultimate provenance. This strongly suggests that garnet removal was not a function of changing provenance, but took place during the sedimentation process, probably by weathering during periods of prolonged alluvial storage. The source of Zone A is not represented in any presently exposed landmass: the required combination of Caledonian granitoids intruding or in immediate proximity to high-grade Archaean-sourced metasediments is likely to have been either to the west, in the northern part of the Shetland Platform, or to the north, in what is now the Norwegian Sea. Zircons in Zone C have a distinctly different age spectrum consistent with a source in the Western Gneiss Region of southern Scandinavia, where there is the required combination of Proterozoic protoliths and Caledonian reworking.