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Provenance of late Carboniferous sandstones in the Pennine Basin (UK) from combined heavy mineral, garnet geochemistry and palaeocurrent studies

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Abstract

Analyses of heavy mineral assemblages, garnet geochemistry and palaeocurrent directions may each independently provide useful information on the provenance of sandstones, but when such datasets are combined the number of options on the location of possible source areas can be greatly reduced. Also, variations in heavy mineral signatures through a stratigraphical section can be explained in terms of switching between source areas, rather than due to unroofing events in a single source area, if palaeocurrent directions change at the appropriate levels. Likewise, seemingly random changes in transport direction indicated by palaeocurrent variations through a short stratigraphical section can be shown by the heavy mineral data to be systematic and related to shifts between source areas. Illustrations of the mutual constraints provided by such combined datasets are drawn from late Carboniferous successions of the Pennine Basin, northern England, where the contributions of detritus from several distinct source terrains and sediment pathways are well documented [Hallsworth, C.R., Morton, A.C., Claoué-Long, J., Fanning, C.M., 2000. Carboniferous sand provenance in the Pennine Basin, UK: constraints from heavy mineral and detrital zircon age data. *Sedimentary Geology* 137, 147–185; Chisholm, J.I., Hallsworth, C.R., 2005. Provenance of Upper Carboniferous sandstones in east Derbyshire: role of the Wales–Brabant High. *Proceedings of the Yorkshire Geological Society* 55, 209–233]. Examples are given of how mineralogically distinct and geographically separated provenances can be identified, how variations in heavy mineral suites can be used to identify whether variations in palaeoflow represent variations in provenance, and how localised mixing/recycling in incised channels can be inferred. The final example defines the regional extent of the widespread northerly-derived fluvial Yeadonian sandstones and provides evidence for the mixing of more local sediment supplies at the basin margins.

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