

Carboniferous sand provenance in the Pennine Basin, UK: constraints from heavy mineral and detrital zircon age data

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Abstract

The integration of heavy mineral analysis and detrital zircon age dating has enabled high-resolution differentiation and characterisation of Carboniferous sandstone provenance in the Pennine Basin of the UK. Heavy mineral data have identified a number of distinct mineralogical groups with different provenance histories and source-area compositions. Single-grain zircon dating on each mineralogical type has placed constraints on the geochronology of the various source terrains. This combination of mineralogical and isotopic data has led to the identification of four distinct source terrains and sediment transport pathways. During the Namurian, the majority of sediment was supplied from the north via the 'Pennine delta'. The source region comprised a high-grade metasedimentary terrain with granitic intrusions. Zircon age data indicate that this lay within the part of Laurentia-Baltica affected by the Caledonian orogeny. Small amounts of sediment were shed northwards from the Wales-Brabant High, on the southern margin of the basin. Most of this was recycled from the Old Red Sandstone but some of it came directly from late Proterozoic igneous basement. Supply via the Pennine delta declined markedly in the Westphalian, with most of the Westphalian A and B being fed from the west. The western source mainly comprised pre-existing sediment, with variable contributions from ultramafic rocks. The precise location of this source remains conjectural: it is unlikely to be within the British Isles given the size and scale of the Westphalian fluvial systems, but the zircon age spectrum cannot be reconciled with derivation from the Appalachians-Newfoundland-Labrador area. Supply from the uplifting Variscan massif to the south became important in late Westphalian B times and continued into Westphalian D. Zircon age data indicate sourcing from Late Carboniferous granites and Cadomian and Icartian basement. Copyright 2000 Elsevier Science B.V. All rights reserved.

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