ELSEVIER

Marine and Petroleum Geology 18 (2001) 319–337

Marine and Petroleum Geology

www.elsevier.com/locate/marpetgeo

Zircon age and heavy mineral constraints on provenance of North Sea Carboniferous sandstones

A.C. Morton[a,b,*], J.C. Claoué-Long[c], C.R. Hallsworth[a]

[a]*HM Research Associates, 100 Main Street, Woodhouse Eaves, Leics LE12 8RZ, UK*

[b]*Department of Geology and Petroleum Geology, Kings College, University of Aberdeen, Aberdeen AB24 3UE, UK*

[c]*Australian Geological Survey Organisation, G.P.O. Box 378, Canberra, ACT 2601, Australia*

Received 24 July 2000; received in revised form 17 November 2000; accepted 25 November 2000

Abstract

The understanding of sediment provenance and sediment transport routes is a key element in establishing reservoir presence in clastic petroleum systems. Determination of sediment provenance is particularly difficult in structurally complex areas and in sequences that have undergone extensive burial diagenesis. This paper describes a method that overcomes these problems, by combining quantitative heavy mineral analysis with detrital zircon age dating. Quantitative heavy mineral analysis identifies differences in sediment provenance within the sample set, and zircon age data provide diagnostic criteria for the identification of the various source terrains. The high degree of resolution shown by this approach is demonstrated using the North Sea Carboniferous as an example. The Carboniferous of the North Sea has suffered extensive diagenetic modification during its complex burial history, is difficult to image with seismic data, and in some areas, notably the central and northern North Sea, preservation is patchy. The understanding of Carboniferous sand provenance is therefore rudimentary. The Tayport and Firth Coal formations (latest Devonian to Early Carboniferous) of the Outer Moray Firth (central North Sea) were derived from a source area to the north of the British Isles, with sediment transported along the proto-Viking Graben. Some local input is recognised in the Firth Coal Formation. The Westoe Coal Formation (Westphalian B) in the southern North Sea was derived from the southeast, probably from the Saxo-Thuringian Zone of the central European Variscides. The Lower Ketch Member (Westphalian C) in the southern North Sea has a northern provenance, with abundant chrome spinel suggesting derivation from ophiolitic material on the Rinkøbing-Fyn High.

Keywords: Zircon age; North Sea Carboniferous sandstones; Heavy mineral analysis