



A detrital zircon provenance study of the Lower Carboniferous sequences in the East Fife section of the Midland Valley of Scotland

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Detrital zircons from the Lower Carboniferous clastic rocks of the Midland Valley of Scotland have been dated using U-Pb laser ablation inductively coupled plasma mass spectrometry (LA-ICPMS) to determine which source areas contributed sediment to the basin during its development, and to investigate whether provenance changed during deposition of these units. Specific provenance detection using U/Pb dating of zircons has never been attempted in these rocks, and there are uncertainties remaining about the regional paleogeographic setting for the Midland Valley. Four samples from the Dinantian Strathclyde Group have been analysed, and the units are locally known as the Fife Ness, Anstruther, Pittenweem, Sandy Craig, and Pathhead formations. The formations are composed of shallow marine, deltaic, fluvial and floodplain deposits and these predominantly siliciclastic sedimentary rocks are interbedded with thin fossiliferous carbonate bands. The samples are quartz arenitic, sub-arkosic and lithic arkosic medium-grained sandstones, predominantly from a fluvial origin. The British Geological Survey developed a lithostratigraphy which is the most used framework for the Strathclyde Group (Browne et al., 1997), but a different biostratigraphical framework based on palynology has been proposed by Owens et al. (2005). In addition to identifying provenance, the zircon age populations for each formation are compared to test which stratigraphic framework is correct. More broadly, the provenance data provides a way to improve the regional palaeogeographic setting for the Midland Valley.

Zircon ages in the Strathclyde Group are dominated by Late Mesoproterozoic to Late Palaeoproterozoic (0.9 – 2.0 Ga) and Early Palaeozoic (350 – 450 Ma) ages which reflect Caledonide (Laurentian-Baltica margin including Scotland, Scandinavia, Greenland, Newfoundland), Grampian and internal Midland Valley source areas. Notable peaks occur at 400 Ma, 1.0 – 1.1 Ga, 1.3 Ga, 1.6 – 1.7 Ga, and 2.7 Ga, and the Proterozoic age peaks are consistent with a Dalradian source. Although the age spectra for each formation are broadly similar, the proportions of age populations differ and age peaks present in the Anstruther Formation are absent in other formations. For instance, the Anstruther Formation has a significantly larger proportion of Archaean-aged zircons compared to the Pittenweem Formation, and contains a 1.3 Ga peak which is absent in the other formations. This suggests that source areas evolved throughout the deposition of the Strathclyde Group. The dominance of Mesoproterozoic and Palaeoproterozoic ages relative to Palaeozoic ages contrasts to similar ages units in the Pennine Basin and offshore North Sea, where the latter dominate the age spectra (Hallsworth et al., 2000; Morton et al., 2001). This may reflect the proximity of the Dalradian terrane and organisation of river systems draining into the Fife section of the Midland Valley during the Dinantian.

References:

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