

# Emplacement and Biodegradation of Oil in Fractured Basement: The 'Coal' Deposit in Moinian Gneiss at Castle Leod, Ross-Shire

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## Abstract

Bitumen veins were formerly mined as 'coal' from Moinian metamorphic basement at Castle Leod, Strathpeffer, Ross-shire. The abundance and spatial concentration of hydrocarbons implies generation of a large volume of oil that exerted a fluid pressure great enough to open veins to 1+ m width. We investigate the fractured Moinian gneiss from Castle Leod, (Strathpeffer, Ross-shire) with a focus on: (i) correlation to their assumed source (Devonian sedimentary rocks); (ii) comparison of the biodegradation and thermal alteration of bitumen, within basement and Devonian sediments; (iii) assessment of the potential for biodegradation to assist in the formation of bitumen. Geochemical (gas chromatography and mass spectrometry, GC-MS) and Petrographic analysis using scanning electron microscope (SEM), were carried out on bitumen-bearing basement rocks from five settings in the Moinian gneiss. Biomarker characteristics, including  $\beta$ -carotane and a high proportion of C28 steranes, correlate the bitumen to Lower Devonian non-marine shales separated from the Moinian basement by a major fault. Bitumen in the Moinian basement has higher diasterane/sterane ratios than bitumen in the Devonian sequence, indicating greater levels of biodegradation, which may reflect more interaction with water in the basement. Replacive bitumen nodules in the Moinian basement, containing Thoriferous/Uraniferous mineral phases, are comparable with bitumen nodules in basement terrains elsewhere. Formation of the nodules represents hydrocarbon penetration of low permeability basement, consistent with high fluid pressure. Bitumen veins are

particularly orientated E-W, and may be associated with E-W transfer faults attributed to Permo-Carboniferous basin inversion.

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