ORGANIC PETROLGY AND GEOCHEMISTRY OF SOLID BITUMENS IN THE EASTERN PAPUAN BASIN

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Introduction

Despite widespread occurrences of oil seeps and petroleum shows in various regions of Papua New Guinea (PNG), current oil production in PNG is almost completely confined to Jurassic-sourced occurrences in the Foldbelt of the western Papuan Basin. Two stratigraphic boreholes drilled in the eastern Papuan Basin (Subu-1 and Subu-2) encountered abundant solid bitumens in two sedimentologically distinct Cretaceous quartz sandstone units, the Pale Sandstone and upper Subu Sandstone. A combination of organic petrology and geochemistry was used to characterise these solid bitumens — remnants of solidified petroleum — so as to get insights into little explored petroleum systems. The aim of this study was to classify the bitumens, establish the process that led to the transformation of oil into solid bitumen, clarify the source(s) of the solidified oil, and assess their thermal maturities.

In this study, the term bitumen is used for particulate, microscopically visible OM that can be formed from oil by either (i) thermal cracking of oil into gas and solid bitumen, (ii) precipitation or de-asphalting from oil by an increase of gas contents, or (iii) microbial biodegradation, often at shallow depth accompanied with water washing (Taylor et al., 1998). Petrographic classification is used, as described by Jacob (1989).

Results

Bitumens are irregularly distributed in the pore spaces of sandstones, mudstones, claystones and packstones, and are concentrated along fractures and in vugs. The bitumens can be microscopically distinguished into two different types: Type I is a dark variety of grahamite, has a low reflectance (<0.2–0.33% Rr), is optically isotropic and appears brownish in transmitted light (Fig. 1a). It is either non-fluorescing or very weakly brown fluorescing when excited with UV light. Type II is a bright, opaque variety of epi-impsonite, has higher reflectance values (0.45–1.0% Rr), and is also optically isotropic (Fig. 1b). Both petrographic solid bitumen types are intimately associated with pyrite and iron oxides, and also with each other. Most samples contain both types of solid bitumen.

Samples containing solid bitumen were Soxhlet-extracted, and the extractable OM was fractionated and geochemically characterised. Two families of extractable OM from samples containing solid bitumens can be distinguished (George et al., 2004), and the stratigraphic distribution of these families is highly irregular and alternating. Geochemical ‘Family A’ solid bitumens are similar to oils produced in the Papuan Foldbelt and indicate that clay-rich, marine Jurassic source rocks containing abundant terrestrial OM input have also generated and expelled oil in the eastern Papuan Basin. Geochemical ‘Family B’ solid