Technical Note:
Waxy oils from lacustrine source rocks

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Many lacustrine-sourced oils of different ages and from different parts of the world are observed to be waxy, containing high proportions of long-chain *n*-alkanes, typically showing a slight predominance of odd carbon number chain lengths (Fig.1). Petroleum geochemists tend to consider long-chain (C_{23} to C_{35}) *n*-alkanes as being typical of higher plants (from wax coatings of leaves), and often use them as potential indicators of land plant contribution to the source rock of an oil. However, in these high-wax lacustrine-sourced oils, they are derived from oil-prone algal biomass.

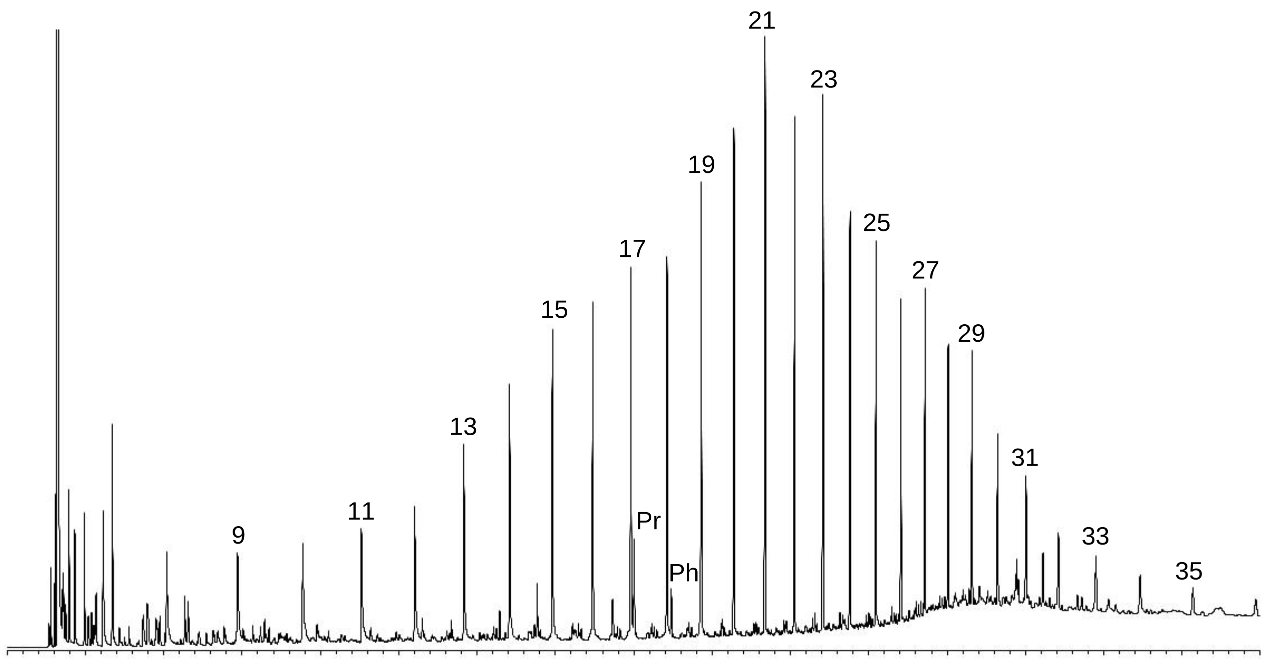

Figure 1: Whole oil gas chromatogram of a lacustrine-sourced waxy oil (North Falkland Basin; Farrimond *et al*., 2015); Pr = pristane; Ph = phytane; *n*-alkanes labeled by carbon number.

Algaenan is a highly aliphatic biopolymer found in various microalgae, being particularly common in lacustrine green algae (e.g. Tetraedron, Scenedesmus, Chlorella & Botryococcus); it is not often found in marine organisms (Kodner *et al*., 2009). Occurring in the cell walls, algaenan contains long hydrocarbon chains joined by ether linkages, forming a recalcitrant structure that is resistant to degradation allowing selective preservation in kerogen (Tegelaar *et al*., 1989).

Other common geochemical characteristics of these lacustrine waxy oils include pristane/phytane ratio usually >1 and high hopane/sterane ratios – both characteristics that are also associated with high land plant input. Their bulk carbon isotopic composition can vary widely from very light to very heavy values depending on the particular source depositional environment and organic matter inputs.

Lacustrine source rocks typically contain Type I kerogens, and these have previously been shown to be often characterized by a narrow range of activation energies leading to hydrocarbon generation over a narrow maturity range (e.g. Dessort *et al*., 1997; Wang Min *et al*., 2011) – in other words, the kerogen falls apart relatively rapidly. This feature is a direct consequence of the composition of the algaenan biopolymer which can comprise a high proportion of the kerogen of such source rocks. An understanding of kerogen kinetics is essential for predicting hydrocarbon generation in basin modelling, and if actual source rock data are lacking, then oil composition can provide information on the likely source; in such cases it is essential to distinguish between long-chain *n*-alkanes from lacustrine algae and those from higher plants, as kerogens with these different organic matter types have very different hydrocarbon generation characteristics.

References:

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