Integrating HyLogger data with well log and geochemical data in the Georgina Basin

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Project Overview

Geoscience Australia is currently assessing the southern Georgina Basin for its unconventional hydrocarbon resource potential, and is compiling a cross-border dataset of all accessible open file seismic, well, geological and geochemical data for public release. Core from 25 wells in the Georgina Basin has been HyLogged by the geological surveys of Northern Territory, Queensland and New South Wales, using HyLogging facilities funded by the National Collaborative Research Infrastructure Strategy (NCRIS) for the National Virtual Core Library (NVCL) Project. In Geoscience Australia’s Georgina Basin project, this HyLogging has been compiled and reprocessed using a consistent set of mineral scalars, and integrated with well log, geochemical and biostratigraphic data.

Study Aims

- To evaluate how HyLogging data can be used to refine the definition of potential unconventional hydrocarbon source/reservoir units in the Georgina Basin (e.g. the Arthur Creek Formation) via mineralogical and spectral characterisation; and
- To examine the inter-relationships and correlations between the measured HyLogging spectroscopic properties of the core and geophysical (log) and geochemistry (TOC (Total Organic Carbon) and XRD) data, and whether spectral proxies can be developed for key data types (e.g. gamma logs and TOC).

Georgina Basin Geological Background

The Georgina Basin is a Neoproterozoic – Paleozoic basin, with thick Cambro-Ordovician marine successions preserved in two depocentres in the southern part of the basin: the Dulcie and Toko Synclines (Ambrose et al., 2001; Dunster et al., 2007). Within these depocentres, the Hay River, Arthur Creek and Arrintrunga Formations are potential source rocks (Ambrose et al., 2001; Boreham and Ambrose, 2012). The current petroleum exploration focus in the southern Georgina Basin is for unconventional hydrocarbons, with the carbonate-dominated Arthur Creek Formation and the shale facies at its base being an important target.

Initial Results

Characterising the lower Arthur Creek Formation

- Geochemical correlations - TOC

Geophysical log relationships

- Geophysical log relationships

Key observations

Initial work has identified interesting relationships between HyLogging spectral data and other data:

- The base of the lower Arthur Creek Formation is often represented by an ‘aspectral wedge’ in the SWIR (Short Wave Infra-Red), which also positively correlates with total gamma count (Fig. 4) and can be mapped across depocentres (Fig. 2).
- Decreasing albedo, increasing aspectral component, and higher gamma count at the base of the Arthur Creek Formation are consistent with the measured increase in TOC (Fig. 3).
- The gamma logs are often inversely correlated with mean SWIR reflectance (i.e. core SWIR albedo); peaks in gamma correspond to lower albedo (Figs. 3,4).
- Changes in dominant carbonate species (dolomite vs calcite) can easily be identified from spectral data and other data: (a) HyLogger spectral properties from the lower Arthur Creek Formation in the Toddy-1 well, including SWIR mean reflectance (albedo), and the aspectral component of the SWIR; (b) vertical guide lines highlight cyclicity, and phase relationships of the data.

HyLogging data thus demonstrate excellent potential to contribute to unconventional hydrocarbon prospectivity assessment in the Georgina Basin (and other basins), via improving the understanding of basin geology and source rock/reservoir properties and distribution, and, mapping of formation boundaries and intra-facies variations. Quantitative predictive estimation of TOC from HyLogging data is an obvious next step for research and development.

References