The Petroleum System of the Central Burma Basin, Onshore Myanmar*

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Abstract

Petroleum systems are characterized by the source rocks, maturity and migration of expelled oil and gas from the source rock to the reservoirs and traps. In the case of the Central Burma Basin, comprising the Irrawaddy, Pyay and Salin sub-basins, the dominant system is Tertiary in age with potential source rocks being from Eocene through Miocene in age. Producing reservoirs consist of Middle Eocene to Middle Miocene sandstones with the main producing reservoirs being the Shwezetaw, Pyawbwe and Kyaukkok formations (Figure 1). To date, all accumulations of oil and gas in the onshore Myanmar are from structural traps associated with compressive-thrust related anticlines. These structures are aligned roughly in a north-northwest to south-southeast direction throughout onshore Myanmar.

Source Rocks Geochemistry

Information obtained from total organic carbon and Rock Eval pyrolysis analyses were used to define the organic richness, the remaining hydrocarbon potential, and the kerogen type. Based on the current well data, the Central Burma Basin is dominated by fluvial-deltaic source rock with the two best intervals being the Late Eocene to Early Oligocene Yaw-Shwezetaw formations (Figure 2 and Figure 3). Other potential source rocks are deposited within the Pondaung, Tabyin and Laungshe formations of Eocene age, and the Late Cretaceous Kabaw Group. The available data suggests these potential source rocks are of lesser source quality and more humic gas prone. At the well locations, these formations are generally over-mature although the small dataset makes it difficult to constrain their characterization.

The more conclusive results on the type of organofacies are derived from detailed geochemical analysis of the reservoired oils. These analyses were used to subdivide the onshore Myanmar sub-basins into several petroleum systems. Oil analysis results essentially indicate the presence of two groups of oils: a well-defined humic/terrestrial group derived from fluvial-deltaic source rocks and a transitional algal to humic group. This is demonstrated by the ternary diagram below (Figure 4). Most of the analysed oils within Eocene to Oligocene reservoirs correspond to the humic/terrestrial group, whereas the Miocene oils relate to the transitional algal/humic depositional environment.

The predominant oils are of humic and more oil-prone coal origin concentrated in Salin sub basin, whereas some oils from Pyay and Irrawaddy sub basins had higher contents of algal material which is believed to be less abundant and locally distributed. Coals and coaly shales are very widespread, but the samples that have been analyzed suggest that the high %TOC intervals are capable of expelling both oil and gas and, as such Type D/E from Pepper and Corvi (1994) have been used in the modeling work discussed here. The hydrocarbons found in reservoirs to date range from oil to condensates to gas. This variation probably reflects more of a reservoir-seal than a source issue (1D modeling results indicate that the higher Hydrogen Index intervals can expel significant oil and gas).

Hydrocarbons are found in the Eocene reservoirs to the north of the Myanmar Central Basin. Further south, hydrocarbons are encountered mainly in the Oligocene, while the Miocene reservoirs are predominant in the southern part of the Myanmar Central Basin. The carbon isotopes from the saturate and aromatic fractions show a possible source rock change between northern and southern data sets. This may suggest multiple source rocks or a regional organofacies change in source rock types (Figure 5).

Basin Modeling

The other aspect of the petroleum system that is important is the maturity of the potential source rocks. Because of the limited regional seismic data available, it was not possible to conduct any detailed modeling. However, 1D basin models were constructed from schematic cross-sections from public domain data. The 1D models were constructed for 3 different locations within the basin (Figure 6).

The modeling results at pseudo well A location indicate that the deepest source rock (Kabaw and Laungshe formations) expels oil and gas throughout the Eocene (Figure 7). At this particular location, these source rocks would expel hydrocarbons before trap formation. Any accumulations and charge would have to rely on the maturation of the shallower source rocks. Based on geochemical analysis results and maturity modeling, the best source rocks identified to date are the Yaw and Shwezetaw formations and these expel hydrocarbons from the Oligocene until present which can contribute oil or gas components to the traps formed in late Miocene time.

Conclusions

The onshore Myanmar petroleum systems are dominated by a fluvial-deltaic organofacies (Type D/E from Pepper and Corvi, 1994). The intervals with greater than 2% TOC tend to be better oil contributors with associated gas (Type D/E), whereas the intervals less than 2% TOC are only gas contributors (Type F). The best candidate source rocks are the Yaw and Shwezetaw formations and both contain a more oil prone Type D/E organic matter assemblage. The majority of oils correlate to this type of source rock.

No typical oil-prone source rocks have been penetrated by wells, and based on detailed analyses of oils, a typical algal (oil prone) type of source, be it marine or lacustrine, does not appear to exist within these sub-basins. A deep Eocene, more oil-prone source rock has always been historically inferred as a major source rock in the Salin Sub-basin; however, the lack of clear information from the Lower to Middle Eocene (or Cretaceous) does not allow any definite conclusions to be drawn on the source rock presence and effectiveness for such stratigraphic interval.

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Wandrey, C.J., 2006, Eocene to Miocene Composite Total Petroleum System, Irrawaddy-Andaman and North Burma Geologic Provinces, Myanmar, Chapter E, *in* C.J. Wandrey, ed., Petroleum systems and related geologic studies in Region 8, South Asia: U.S. Geological Survey Bulletin 2208-E, p. 26.

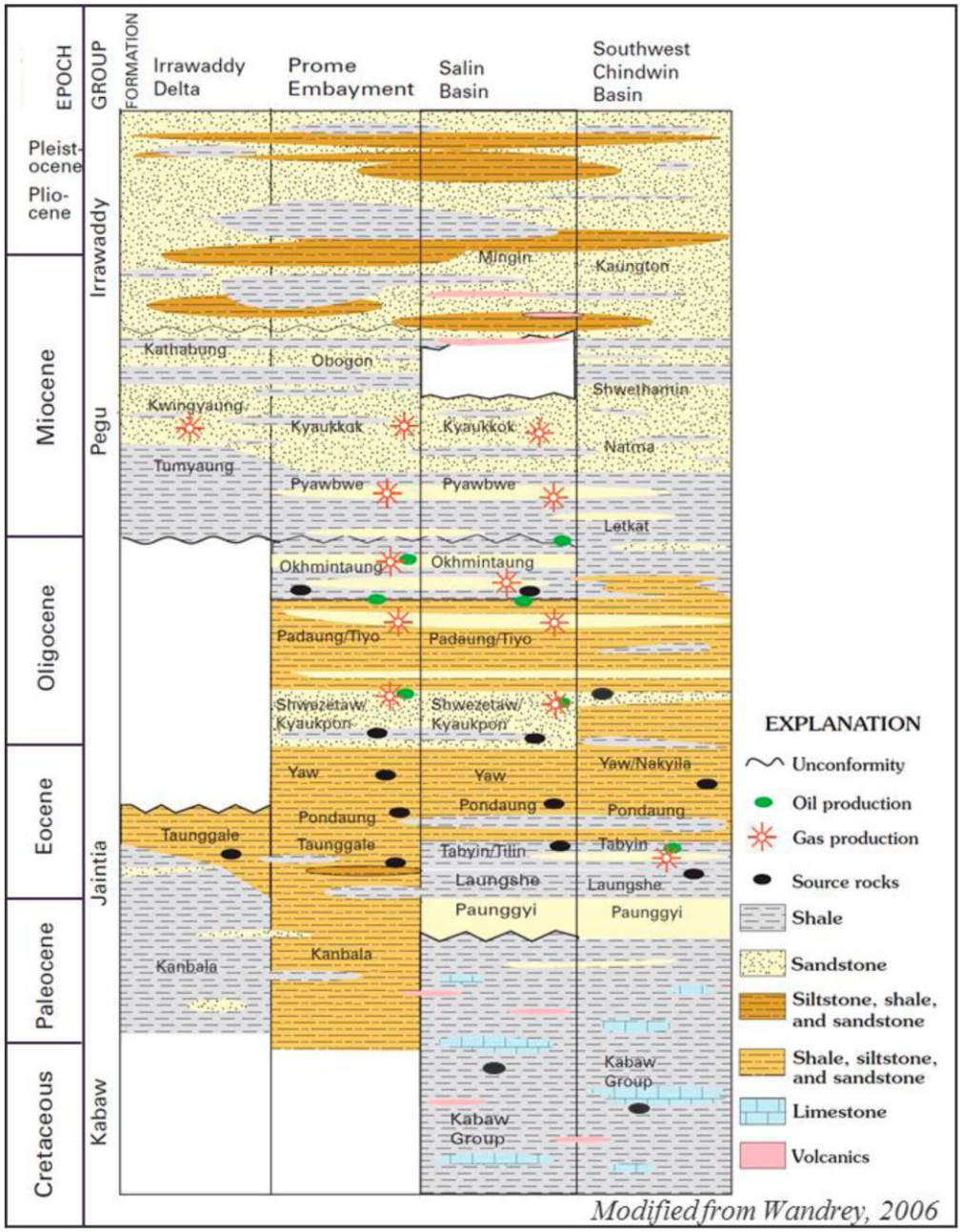

Figure 1. The stratigraphy of onshore Myanmar.

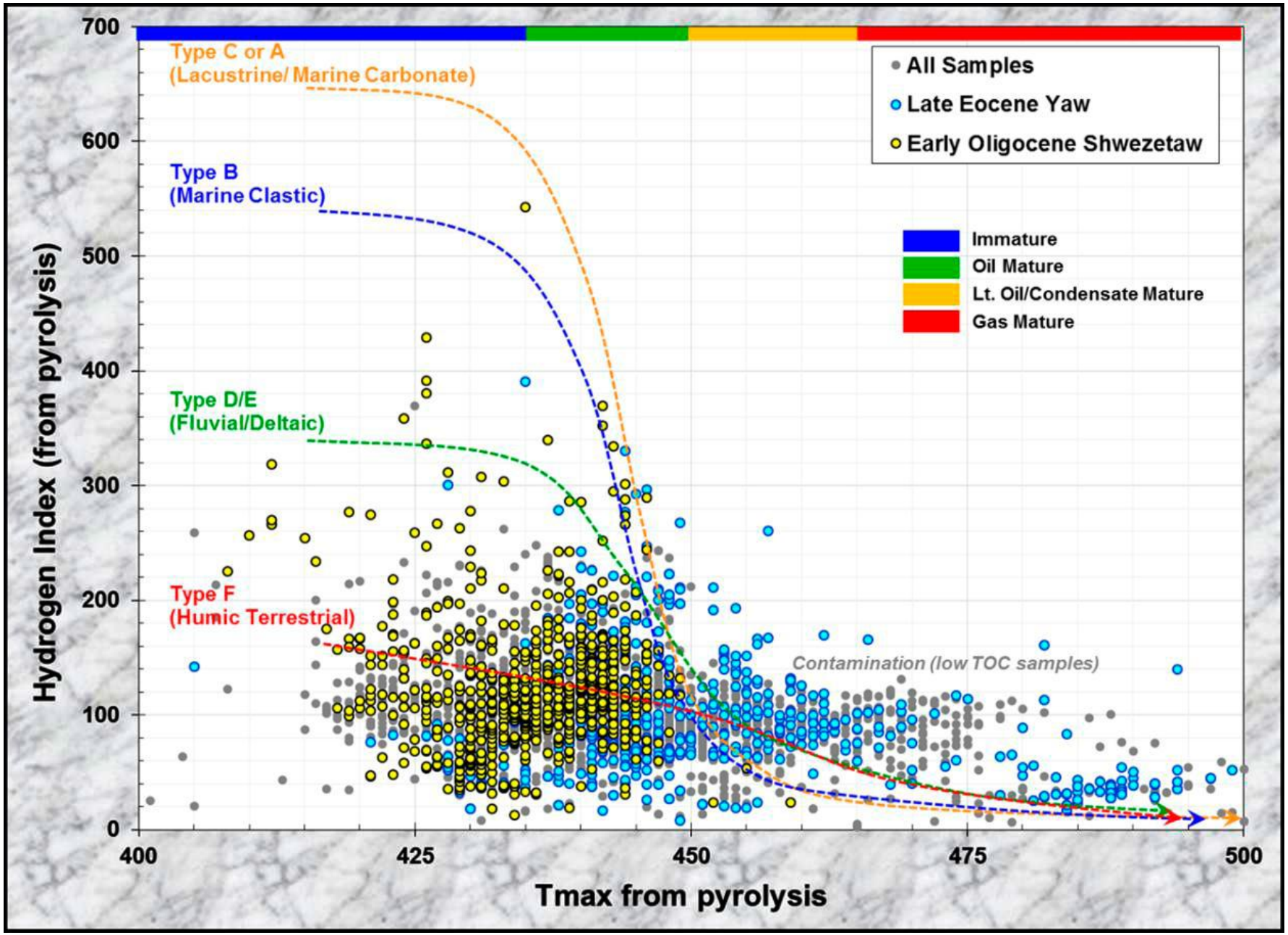

Figure 2. The source rock type.

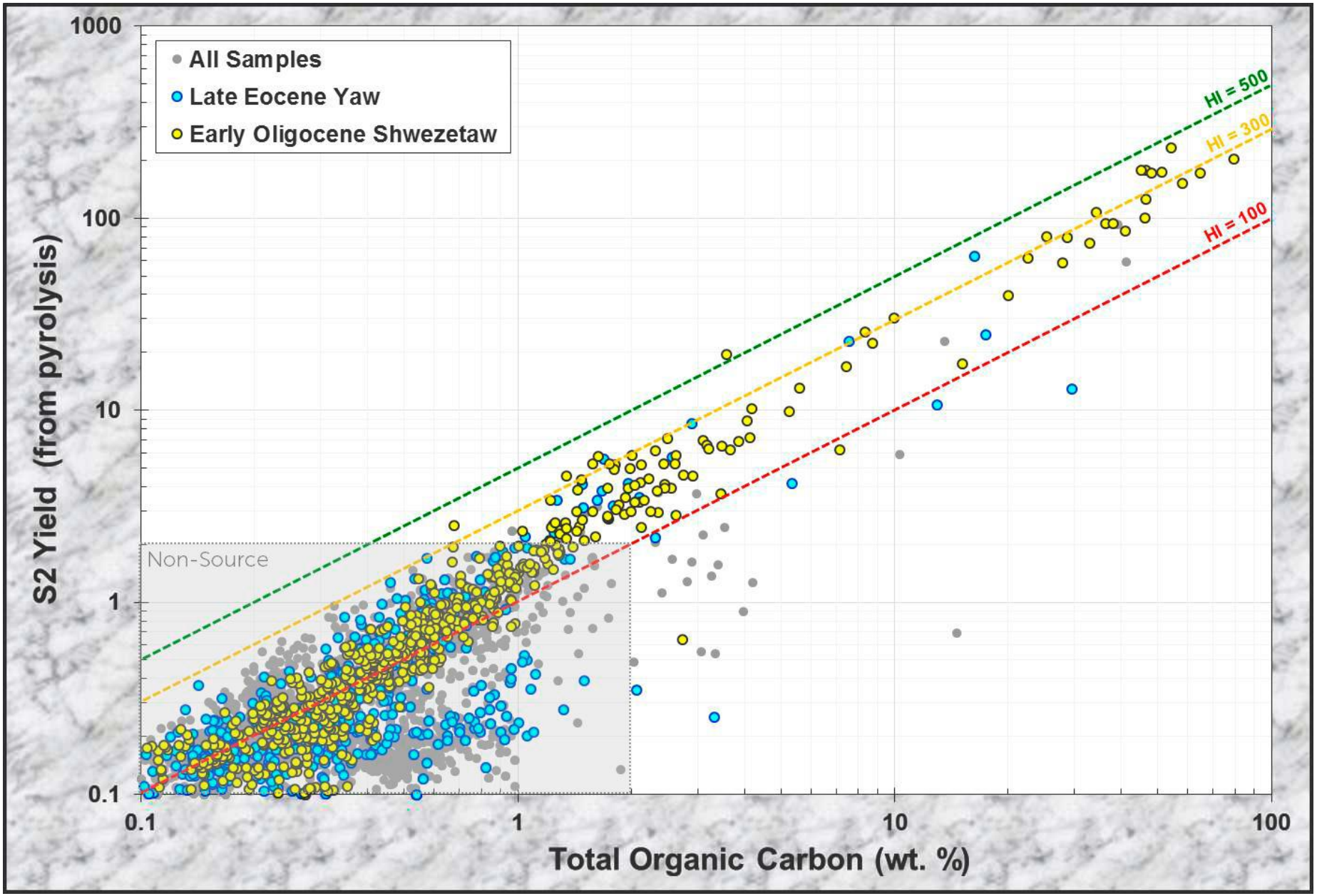

Figure 3. Source rock richness and potential.

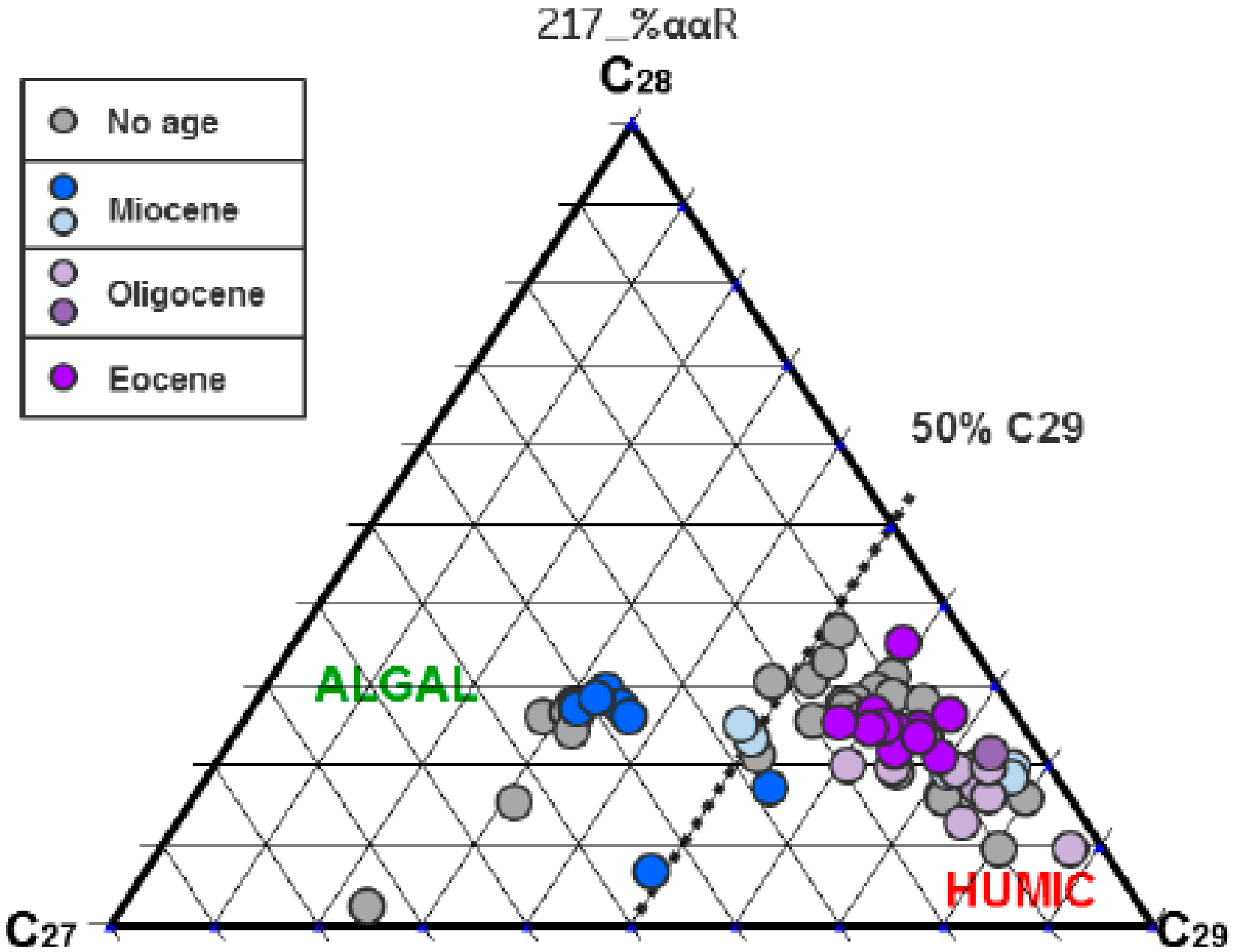

Figure 4. Organofacies characterization based on oils: regular steranes distribution.

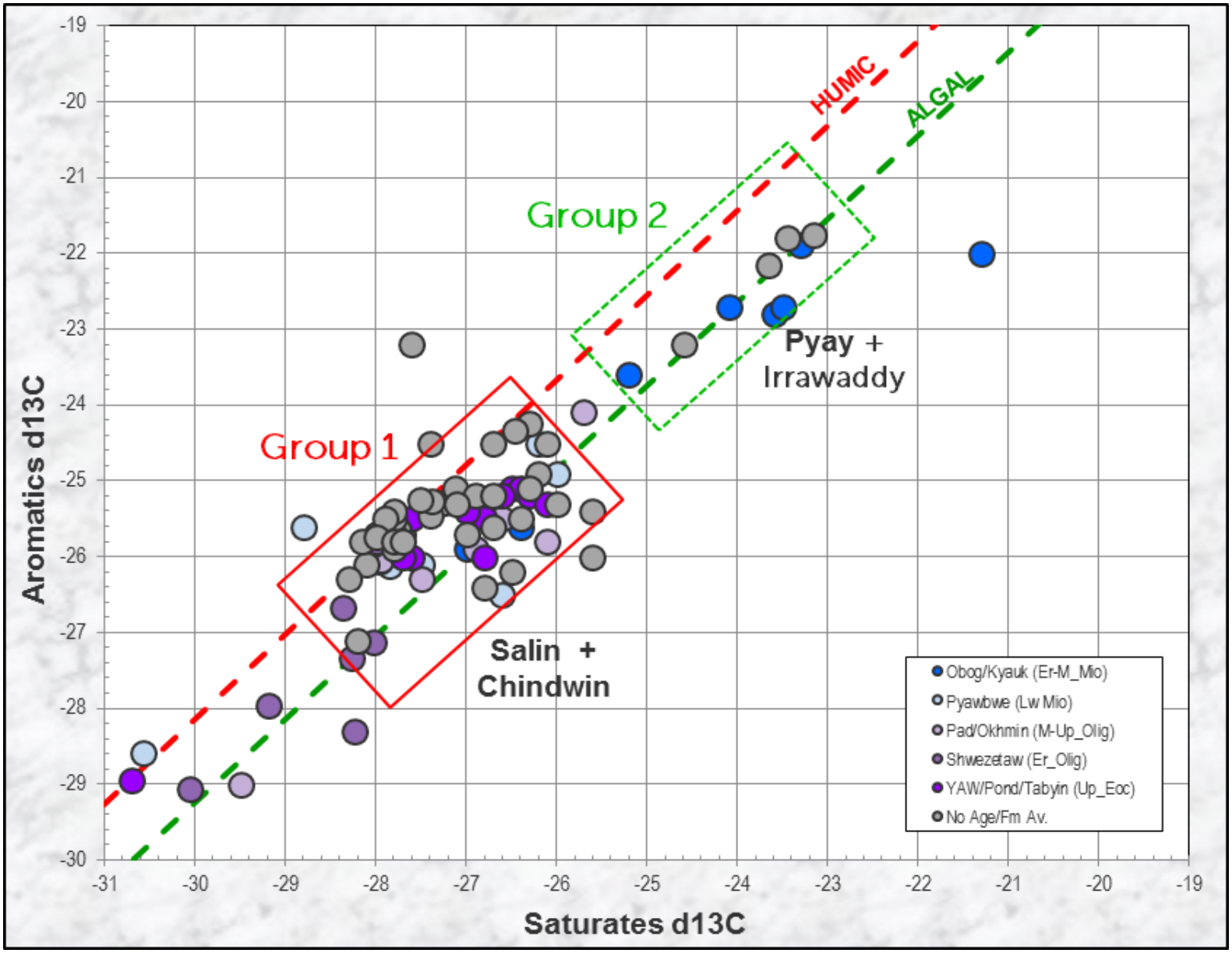

Figure 5. Saturate versus aromatic fraction carbon isotope distributions suggest a dominant oil family centered about -27ppt saturates/-26ppt aromatics for the Salin sub-basin with secondary families with heavier isotope compositions in the Pyay and Irrawaddy sub-basins.

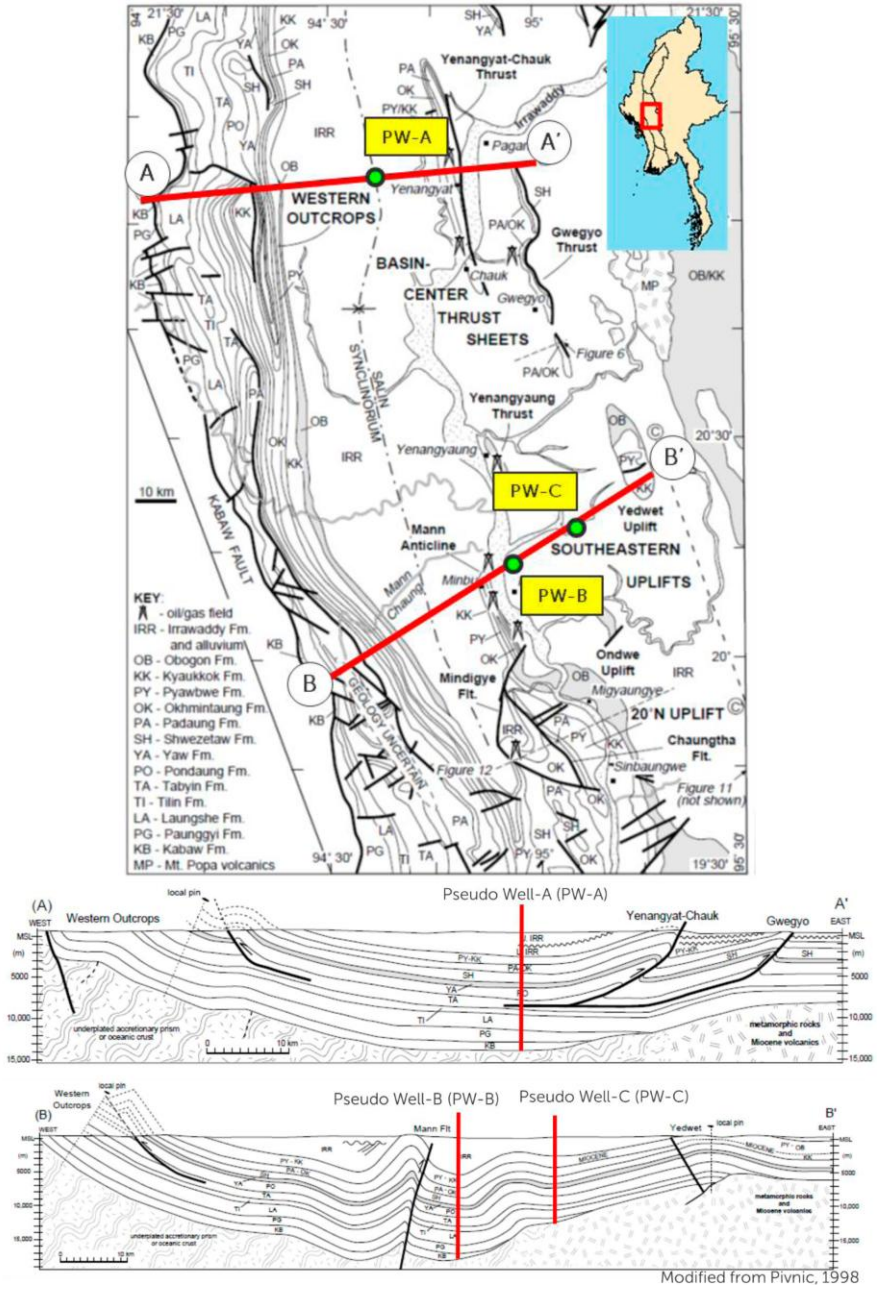

Figure 6. Geologic map, cross section, and locations of the pseudo wells.

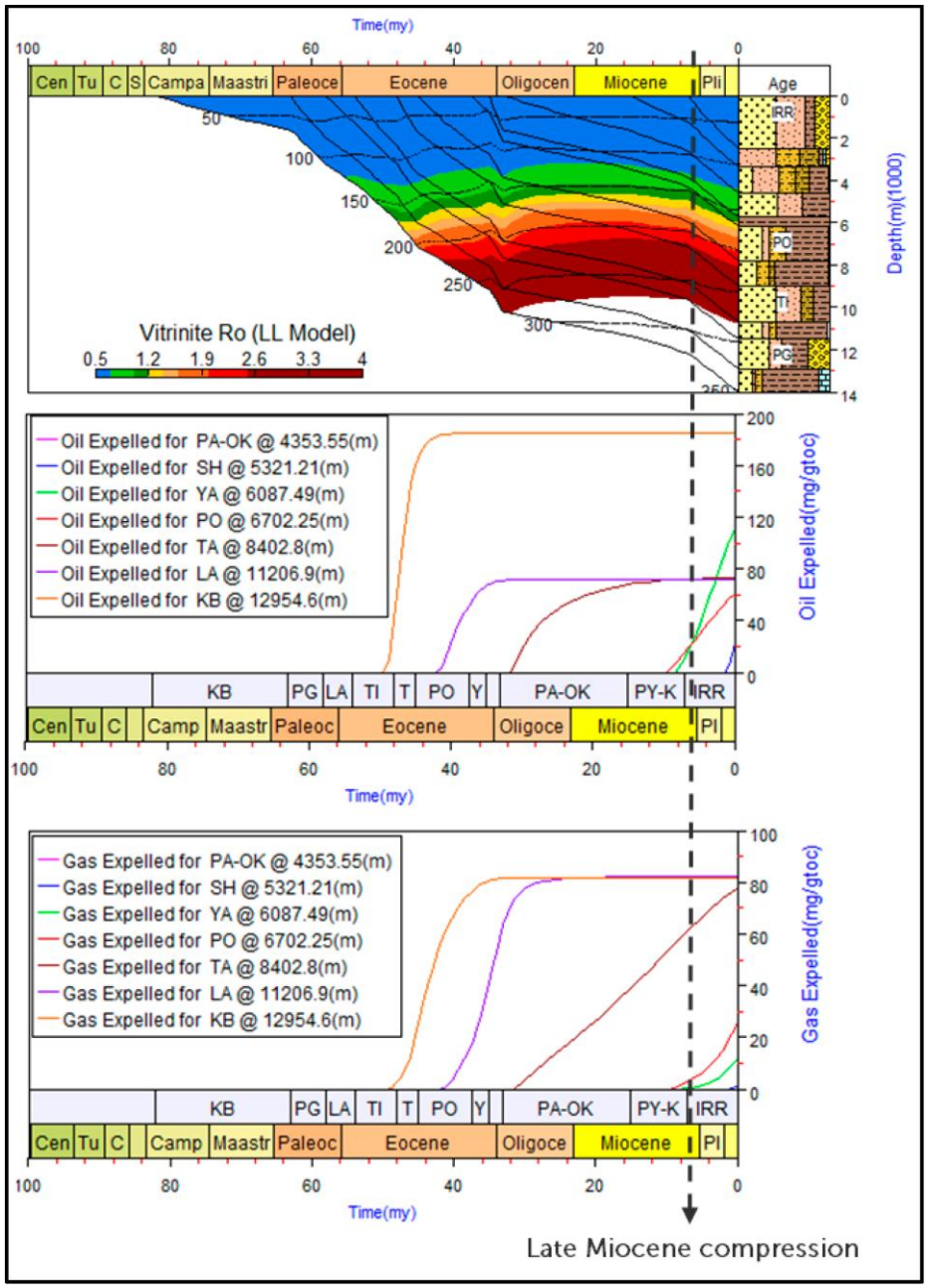

Figure 7. 1D modeling result at pseudo well A location.