A Source-to-Sink Study in Myanmar: Implications for Exploration*

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Abstract

Myanmar is an emerging hydrocarbon province with underexplored potential in its Cenozoic onshore and offshore basins. These basins are filled with thick successions (up to 15 km) of predominantly clastic rocks derived from the hinterland areas that are the focus of this study. The nature of these sediments varies depending on the bedrock, vegetation and climate of the hinterland source areas and the evolution of the transport pathways (rivers) that move sediments to the depocentres. Analysis of these processes forms the basis for the source-to-sink studies which relate variations in sediment flux to the morphological and sedimentological evolution of an erosional-depositional system (Sømme et al., 2009). This can influence reservoir character, quality and distribution, along with burial history, maturity and connectivity. We will look at two components of source-to-sink analysis: drainage reconstruction and provenance assessment.

Paleo-River Drainage

There is some disagreement between the different interpretations for the paleo-river systems in Myanmar (Clark et al., 2004; Licht et al., 2013, 2015; Robinson et al., 2012). Some authors (Clark et al., 2004; Robinson et al., 2012) suggested that in the Eocene-Early Miocene, the Irrawaddy River was connected with rivers draining from the Himalayas, e.g. the Tsangpo (Figure 1). This would imply the existence of a large passive source-to-sink system with intermittent sediment delivery into the Andaman or Martaban basins; it would also probably indicate the presence of the long, low-gradient slope (over 20 km) that resulted in a basin-floor fan offshore (Sømme et al., 2009). Other authors (Licht et al., 2013, 2015), however, argued that during the Eocene, rivers were draining westwards from the area of the Indo-Burman Ranges and possibly from the Shan Plateau, implying that most siliciclastic sediments were shed into the Bay of Bengal and not into the Gulf of Martaban (Figure 1). In this scenario, the presence of a small, active source-to-sink system is more likely. This would imply high discharge ratios (100-1,000), an efficient response to climate changes and uplift rates, and potentially more effective sediment bypass off the shelf into the deeper water (Sømme et al., 2009).

To resolve these uncertainties, we have integrated published data with Getech's drainage and paleogeographic reconstructions and Earth system models. Preliminary compilation of published detrital zircon U-Pb age data from the Rakhine Basin (Allen et al., 2008; Naing et al., 2014; Robinson et al., 2014) shows that Precambrian zircons are significantly more abundant in Present Day river sands compared to those in the Miocene, Oligocene and Eocene strata (Figure 2 and Figure 3). This implies a provenance change and increased sediment reworking between the Miocene and the Present Day, and this is consistent with the theory of rapid uplift of the Indo-Burman ranges since the Late Miocene which was proposed by Licht et al. (2015). While the latest Eocene-Early Miocene emergence of the Indo-Burman ranges and their rapid uplift since the Late Miocene alone does not exclude the possibility of the palaeo-Irrawaddy-Tsangpo connection, abundant siliciclastic input into the Gulf of Martaban during the Eocene-Early Miocene, which would be expected in this scenario, contradicts with the presence of reef carbonates in the area (e.g. the Yadana Platform). Getech is currently updating the crustal architecture/plate model interpretations to gather better understanding of causes for drainage and therefore provenance in the Cenozoic.

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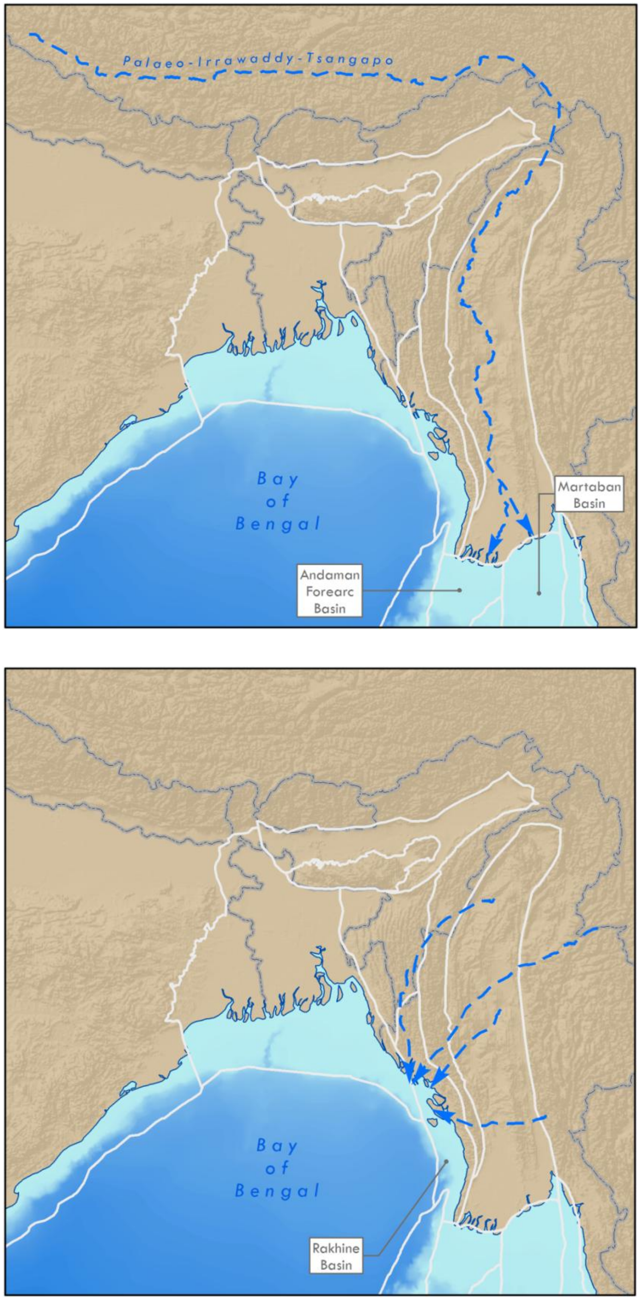


Figure 1. Eocene palaeodrainage trends (dashed blue line) in Myanmar. The top figure shows the palaeo-Irrawaddy-Tsangpo connection proposed by Clark et al. (2004) and Robinson et al. (2012), whereas the bottom figure shows the interpretation proposed by Licht et al. (2013, 2015).

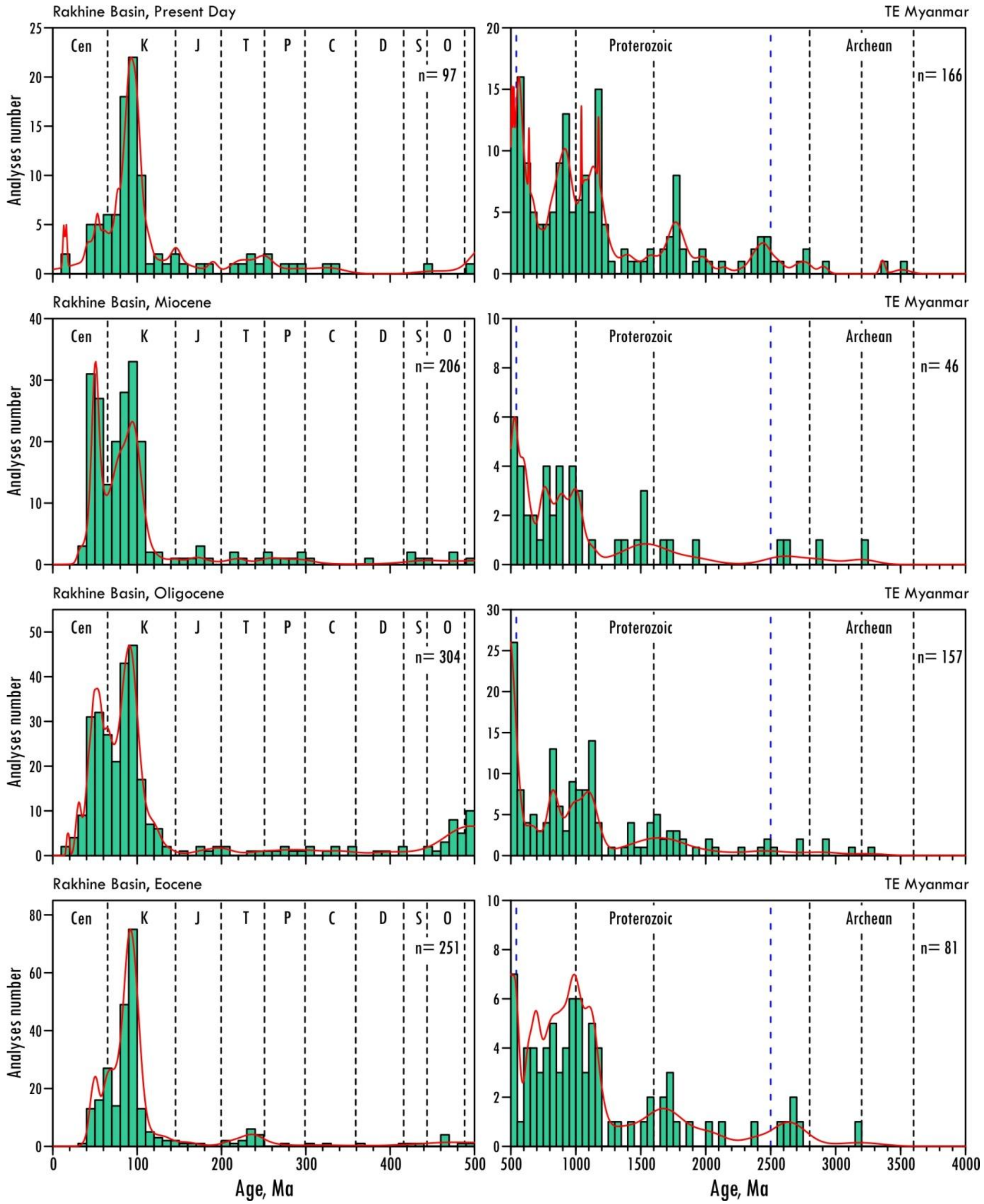
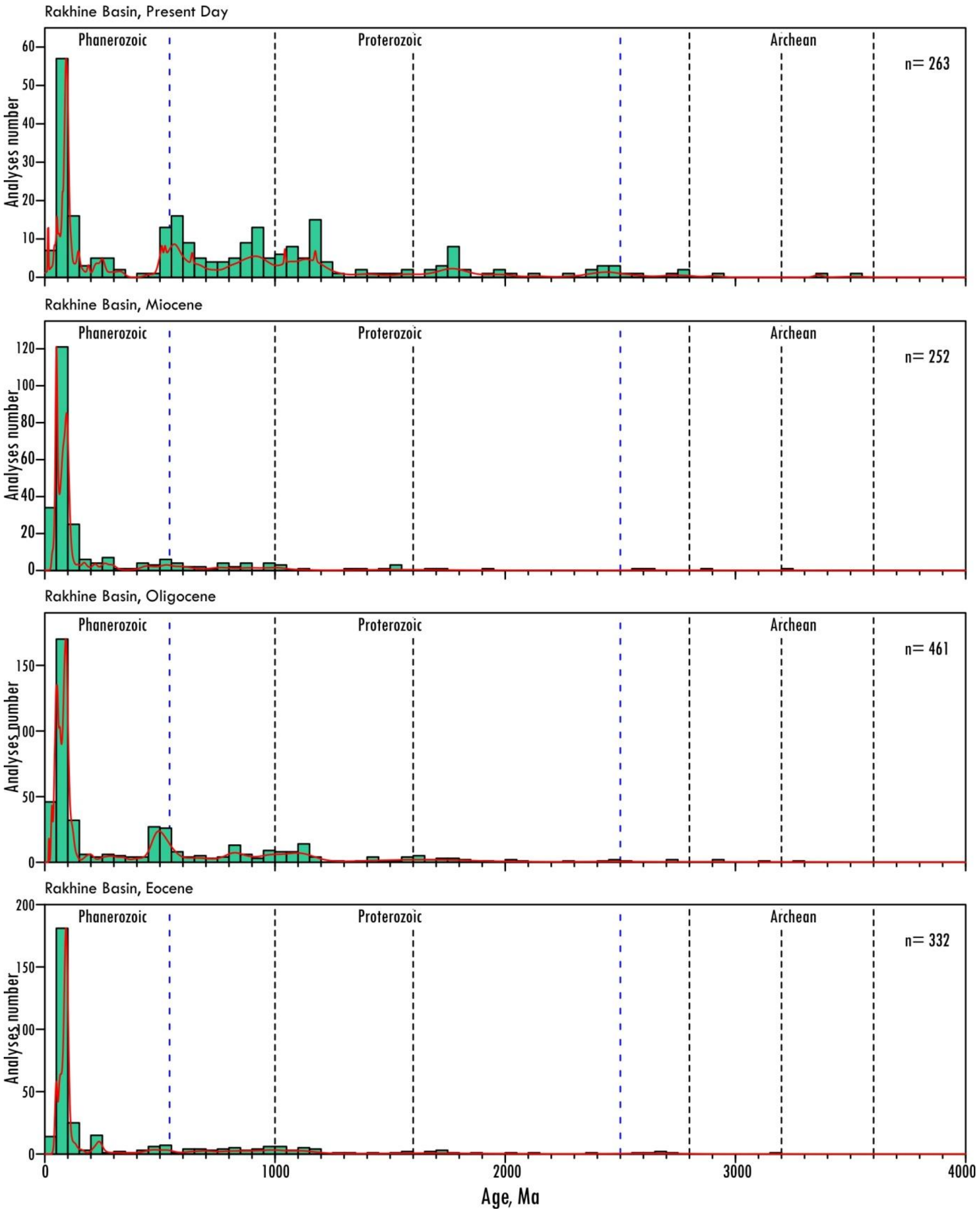


Figure 2. Histograms and probability density curves (red lines) showing distribution of detrital zircon U-Pb ages in Eocene, Oligocene and Miocene strata and in the Present Day river sands. Data from Allen et al. (2008), Naing et al. (2014) and Robinson et al. (2014). The plots on the left show 0–500 Ma ages (bin width 10 Ma); the plots on the right show 500–4,000 Ma ages (bin width 50 Ma). See Figure 3 for the whole spectrum of ages (0–4,000 Ma).



Rakhine Basin, Present Day

Rakhine Basin, Miocene

Rakhine Basin, Oligocene

Rakhine Basin, Eocene

Figure 3. Histograms and probability density curves (red lines) showing distribution of detrital zircon U-Pb ages in Eocene, Oligocene and Miocene strata and in the Present Day river sands. Data from Allen et al. (2008), Naing et al. (2014) and Robinson et al. (2014). Bin widths are 50 Ma. Note that Proterozoic and Archean zircons are most abundant in the Present Day (Recent) river sands.