Potential for lacustrine source rocks in Triassic synrift basins offshore Eastern North America

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THESIS

Recent discoveries of super giant pre-salt oil fields in Brazil's offshore basins, and related discoveries in its African conjugates, have highlighted the great importance of syn-rift / pre-breakup fluvial-lacustrine successions to the success and efficiency of the petroleum systems. Improvements in seismic acquisition and processing technologies were keys in imaging the architecture of the underlying rift basins, and interpreting the basin fill and internal depositional facies later confirmed by drilling. This knowledge has highlighted the search for similar depositional settings and source successions offshore Nova Scotia. This poster postulates that older Middle to Late Triassic lacustrine successions do exist, and previous interpretations of their source rock potential at the time of their deposition may have to be reconsidered.

INTRODUCTION

Syn-rift basins of the Middle Triassic to Early Jurassic age Newark Supergroup (SG) of Eastern North America are exposed onshore and extend into adjacent offshore areas, with equivalent basins in Morocco / Northwest Africa and Iberia (**Figure 1**). These basins are dominantly extensional though some reveal evidence of an Early to Middle Jurassic compressional event (Withjack *et al.* 2005). Well documented lacustrine source successions occur in a number of the onshore U.S. basins. Although no commercial petroleum discoveries have been made, hydrocarbon shows in outcrops and a few wells are documented confirming that a working petroleum system existed at some point in time. Comparison of the reflection profiles from the basins reveals strong similarities. Interpretations of their filling successions are used to postulate the potential of Middle to Late Triassic age lacustrine facies in both, and in turn the climatic conditions during their deposition. Together, this has significant implications regarding the potential creation and preservation of organic material and subsequent contributions to petroleum systems.

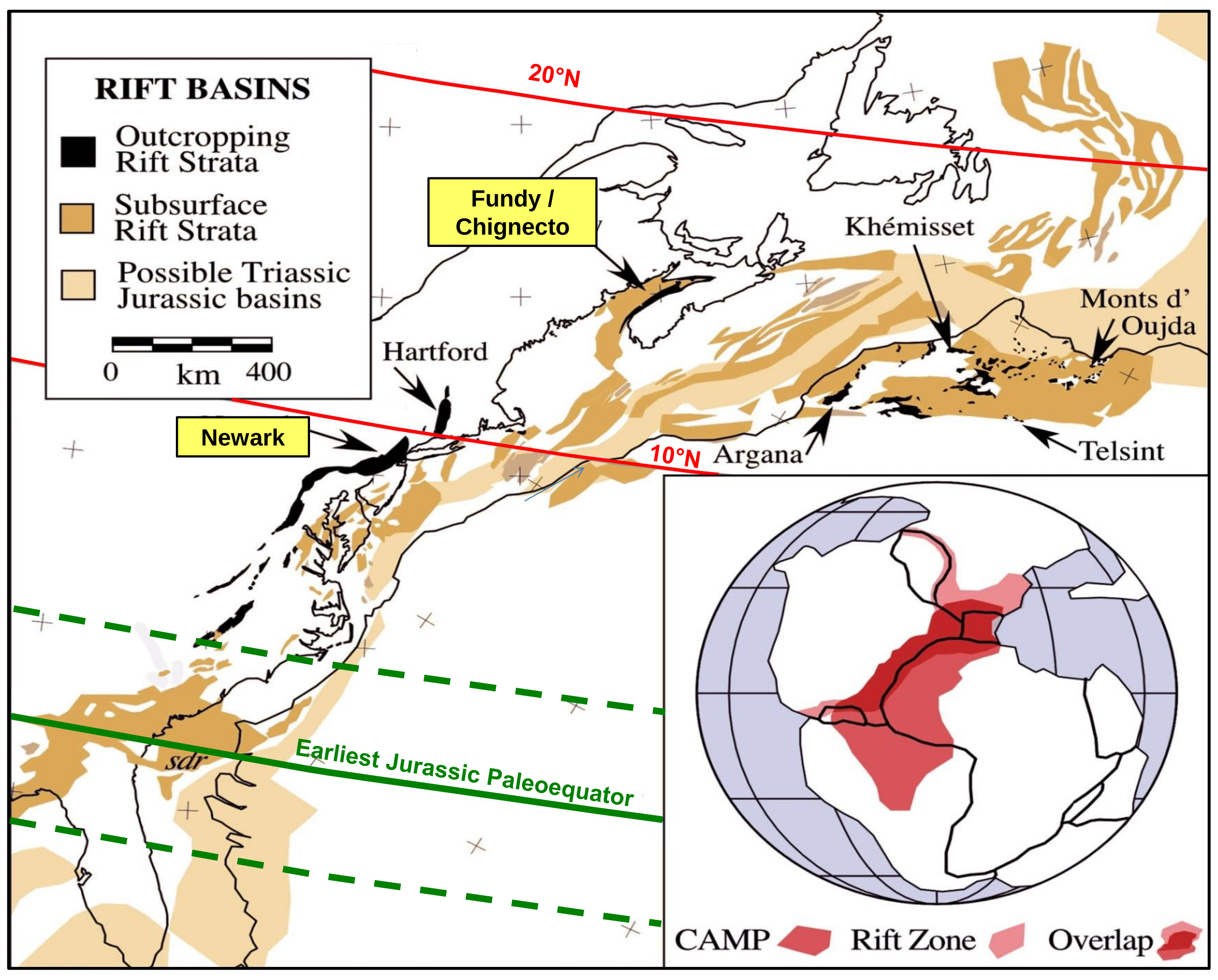


Figure 1: Paleo-reconstruction of the Central Atlantic and syn-rift basin distribution at approximately earliest Jurassic time prior to breakup. The dashed green line indicates the approximate limits of the early Jurassic tropical region (Olsen & Kent 1996; Whiteside et al. *2011). Modified after Olsen & Et Touhami (2008).* ▶

DISCUSSION

The basin-fill model for the first order sedimentary successions of Newark SG extensional basins reflects the coupling of tectonically-driven accommodation and paleolatitudinal changes over time. Four tectonostratigraphic (TS) units have been defined by Olsen (1997) and Olsen *et al.* (2000) (**Figure 2**). TS I is an unconformity-bounded, early synrift fluvial-lacustrine sequence of Late Permian age. TS II is composed of dominantly fluvial (and some lacustrine) strata believed representative of an underfilled, hydrologically-open basin (subsidence < sedimentation). This is followed by either a closed basin or one in hydrological equilibrium (subsidence ≥ sedimentation) dominated by lacustrine (TS III), and later playa / lacustrine (CAMP volcanics) successions (TS IV). These units tend to be separated by subtle unconformities.

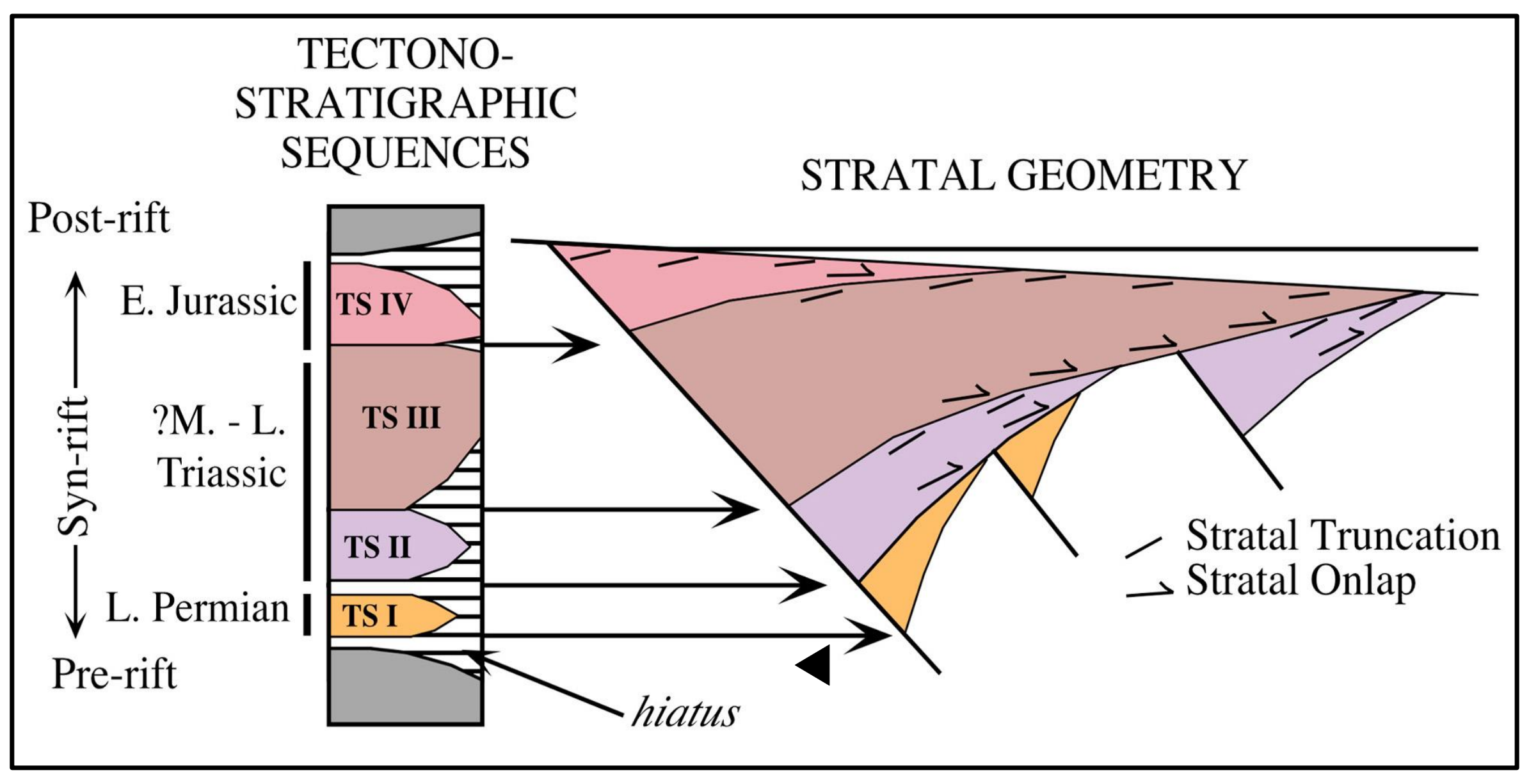


Figure 2: Tectonostratigraphic (TS) model of the Newark Supergroup basins, Eastern North America. Olsen (1997); Olsen & Et Touhami (2008).

As a result of the northward drift of Pangea, the climate reflecting the paleolatitudinal position of the Newark SG basins had a direct influence on their facies development and lithologies, particularly the lacustrine successions (TS III) (**Figure 3**).

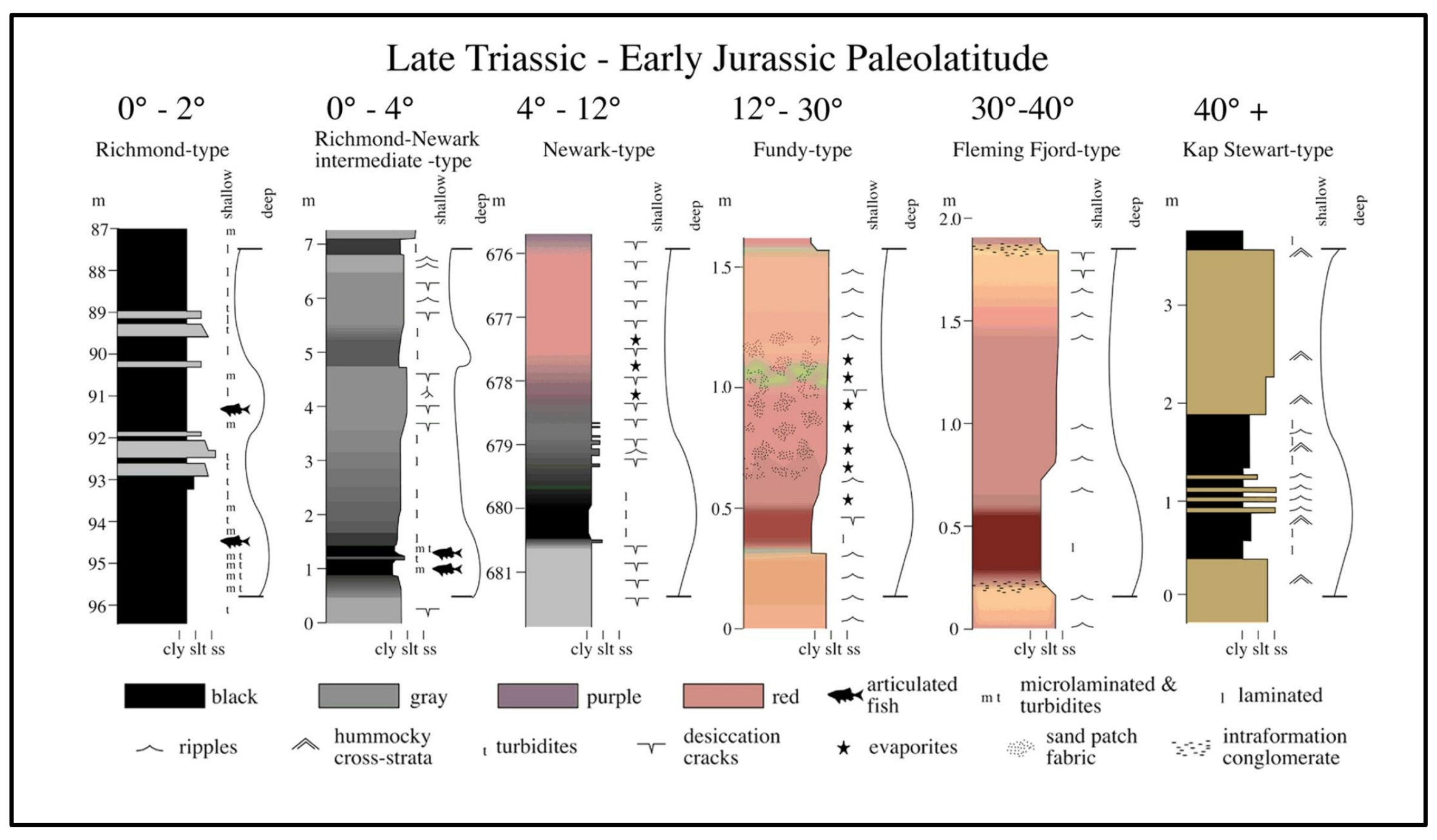
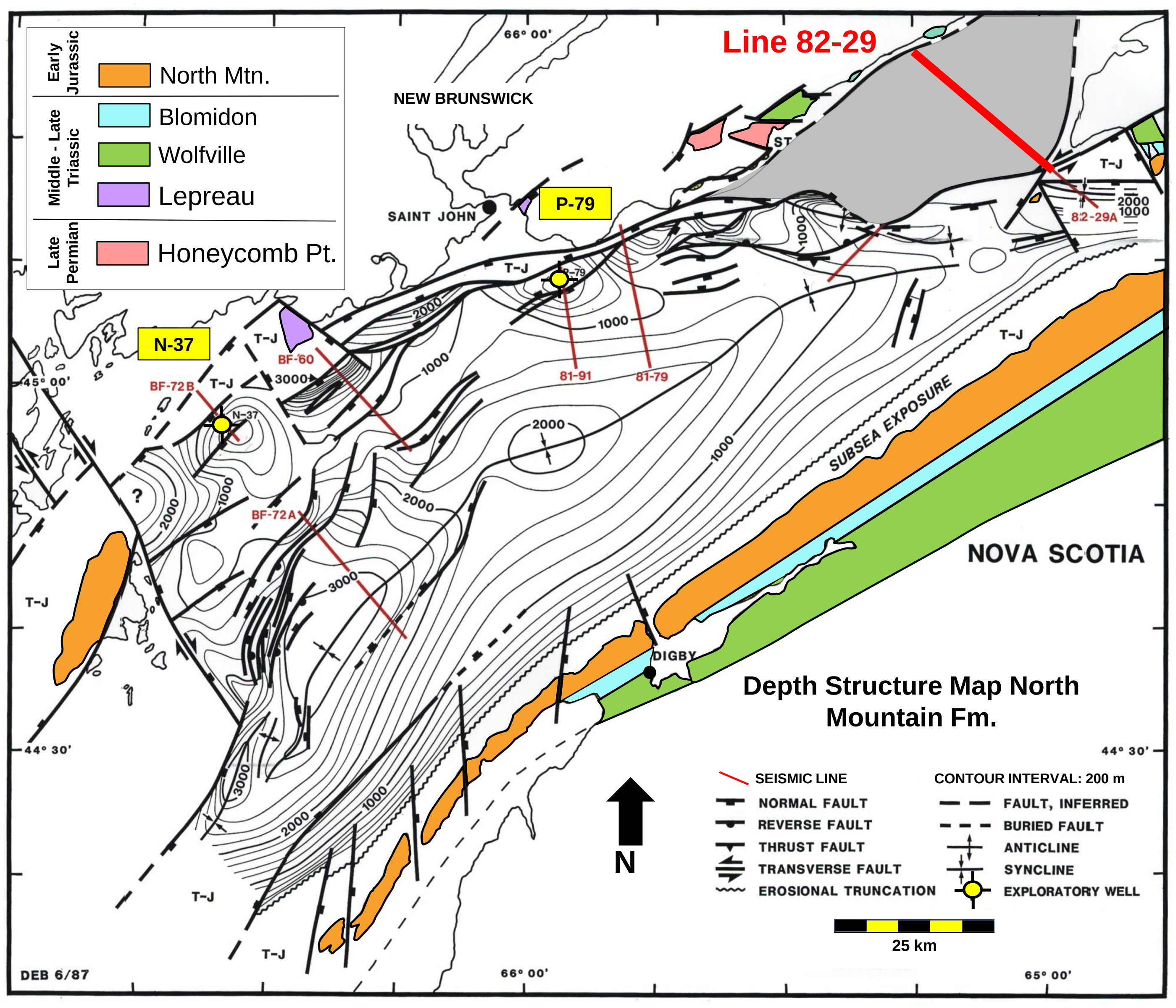


Figure 3: The influence of climate and latitudinal position on cyclic lacustrine deposition (Olsen & Kent 2000; Olsen & Et Touhami 2008).

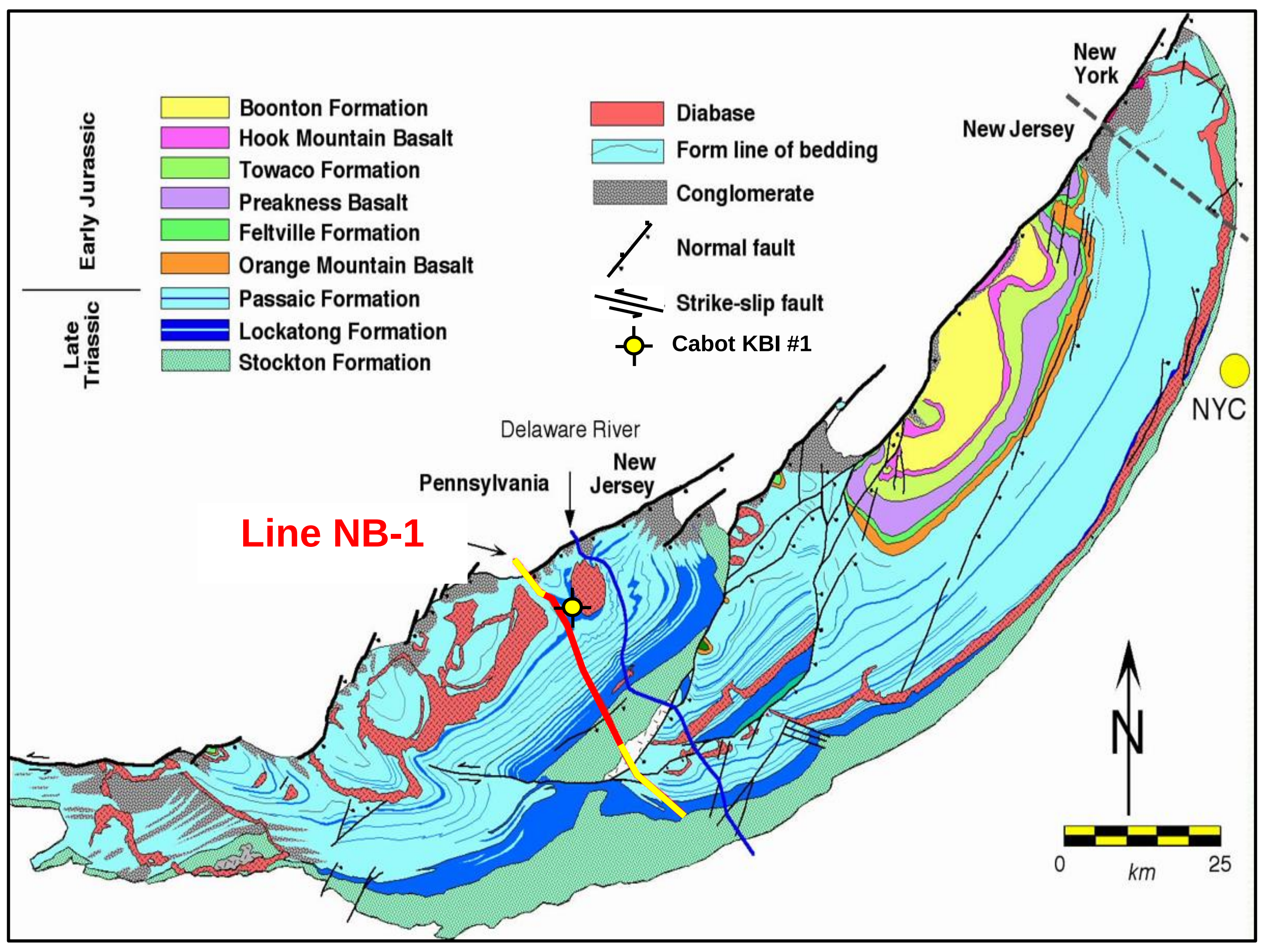
Through time, the southern basins transited across the paleoequator and remained in the humid tropics whereas basins to the north moved from the humid tropics into the drier subtropical region.

In the Newark and Fundy-Chignecto basins, the TS units are well exposed (**Figures 4 & 5**) and clearly recognised in the subsurface of the latter (Withjack *et al.* 1995). Within the former, lacustrine successions of the Lockatong and Passaic formations have been studied in great detail through outcrops and a massive coring program (Newark Basin Coring Program) that permitted the creation of an extraordinarily detailed and high resolution astronomically-calibrated geomagnetic polarity time scale for over 5 km of strata of Late Triassic to earliest Jurassic in the Newark Basin (c.f. Olsen *et al.* 1996; Olsen & Kent 1996, 1999).



◀ *Figure 4: Fundy Basin geologic map. The Chignecto Subbasin's areal extent is shown in grey, with detailed geology in Figure 9. Seismic mapping reveals at least 10,000 m of strata in the basin: 6000 m pre-CAMP sediments (Wolfville and Blomidon Fms., 1000 m basalts (North Mountain Fm.), and at least 3000 m post-CAMP sediments. The latter McCoy Brook Fm. is estimated to extend from the Hettangian to perhaps the Aalenian (Middle Jurassic, post-breakup). Modified after Wade* et al. *(1996).*

Figure 5: Geologic map of the Newark Basin. The red segment of the seismic line is shown in Figure 6. Slightly modified after Withjack et al. *(2012).* ▶



Note: Scales are identical in both figures.