Triassic Stratigraphy and Facies Evolution (Tethys Himalaya, Thakkhola, Nepal)

POSTER

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1. Triassic stratigraphy

See Abstract of talk "Triassic rifting and Tethyan paleoenvironment..."

2. Triassic facies evolution and global tectonic/eustatic events

Three main factors governed the patterns of Triassic through Middle Jurassic facies along the eastern Tethyan margin of Gondwana: paleolatitude, relative sea level, and regional tectonics.

Northwest Australia and the adjacent Himalayan margin lay at about 40°S during the Middle Triassic, drifted steadily northward into tropical latitudes to reach 20°-25°S in the Rhaetian to Early Jurassic, then again returned to temperate latitudes in the Middle Jurassic. As a result, shallow-water carbonate platforms are favored during the Rhaetian and Early Jurassic: Aghil Formation in Karakorum, Kioto Formation in Ladakh, Jomosom Formation in Central Nepal, Pupuga Formation in southern Tibet, reef limestone on the Wombat Plateau and in Timor. Such shallow-water carbonate facies are rare during the Middle Triassic to early Norian times or during the Middle Jurassic when most of these regions were in temperate latitudes. In addition, the influx of terrigenous clastics was also governed by the climatic regime, with increased clay input under tropical chemical weathering conditions and increased detrital components favored under subtropical monsoonal or seasonal temperate climatic conditions where physical weathering is important.

Throughout this northward drift in paleolatitudes, Northwest Australia was always further from the equator than the Himalayan and Karakorum regions which were in the most tropical latitudes. As a result, the facies are generally more calcareous on the Himalayan margins than on the Northwest Australian margin, and shallow-water carbonate deposition may continue into the Middle Jurassic in the more tropical latitudes (e.g., Ladakh and Pakistan).

Following a rapid deepening in the basal Triassic (Griesbachian transgression), the margins display a progressive shallowing. This culminated in deltas prograding over Middle Triassic to Carnian mudstone on the Northwest Australian shelf and over Norian shallow-shelf sediments on the Himalayan margin. A mid- to late-Carnian episode of rift tectonics is indicated by the formation of fault-bound basins on the Australian margin and by volcanics in the Ladakh region; this may have contributed to the increased influx to terrigenous clastics during the Norian.

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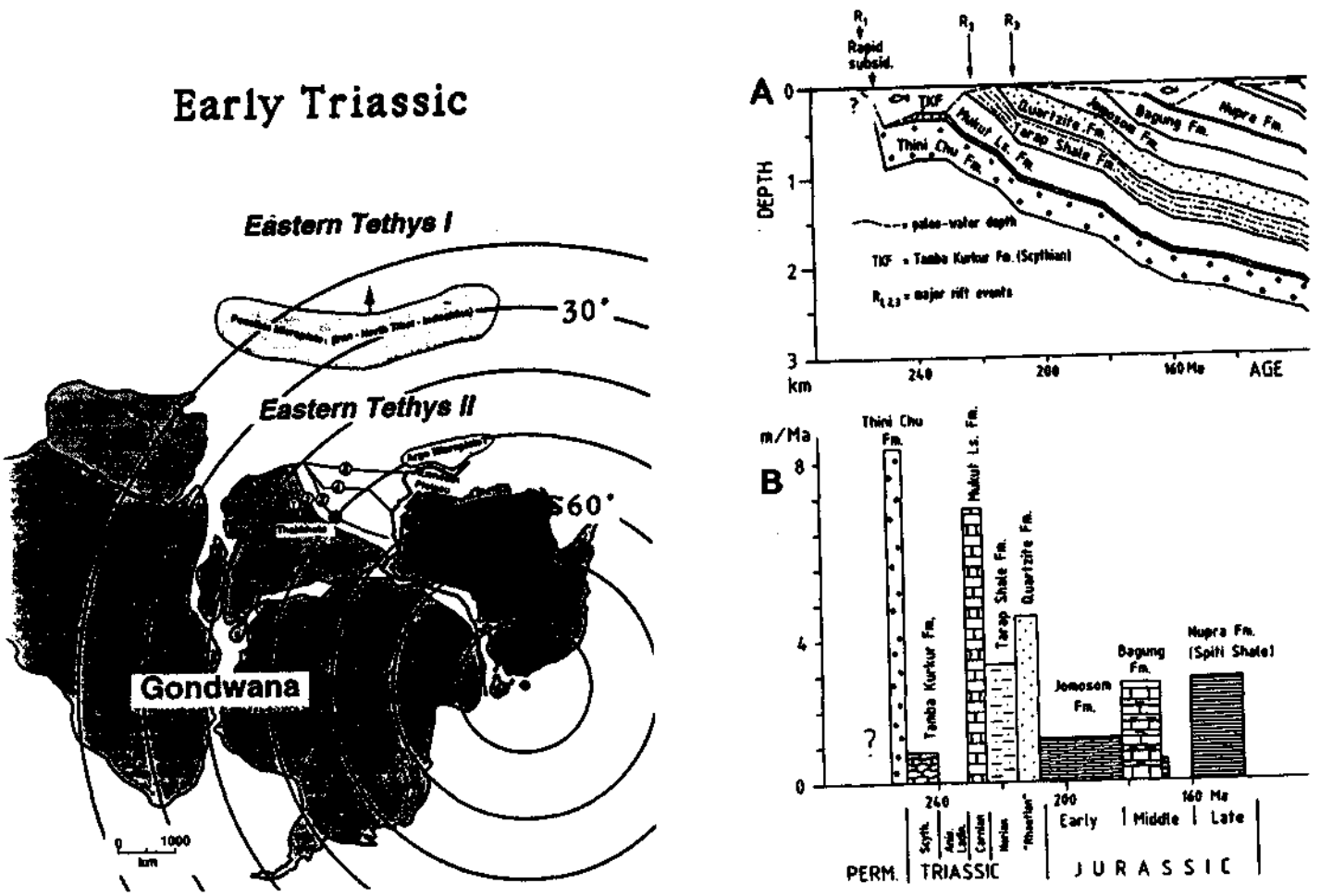
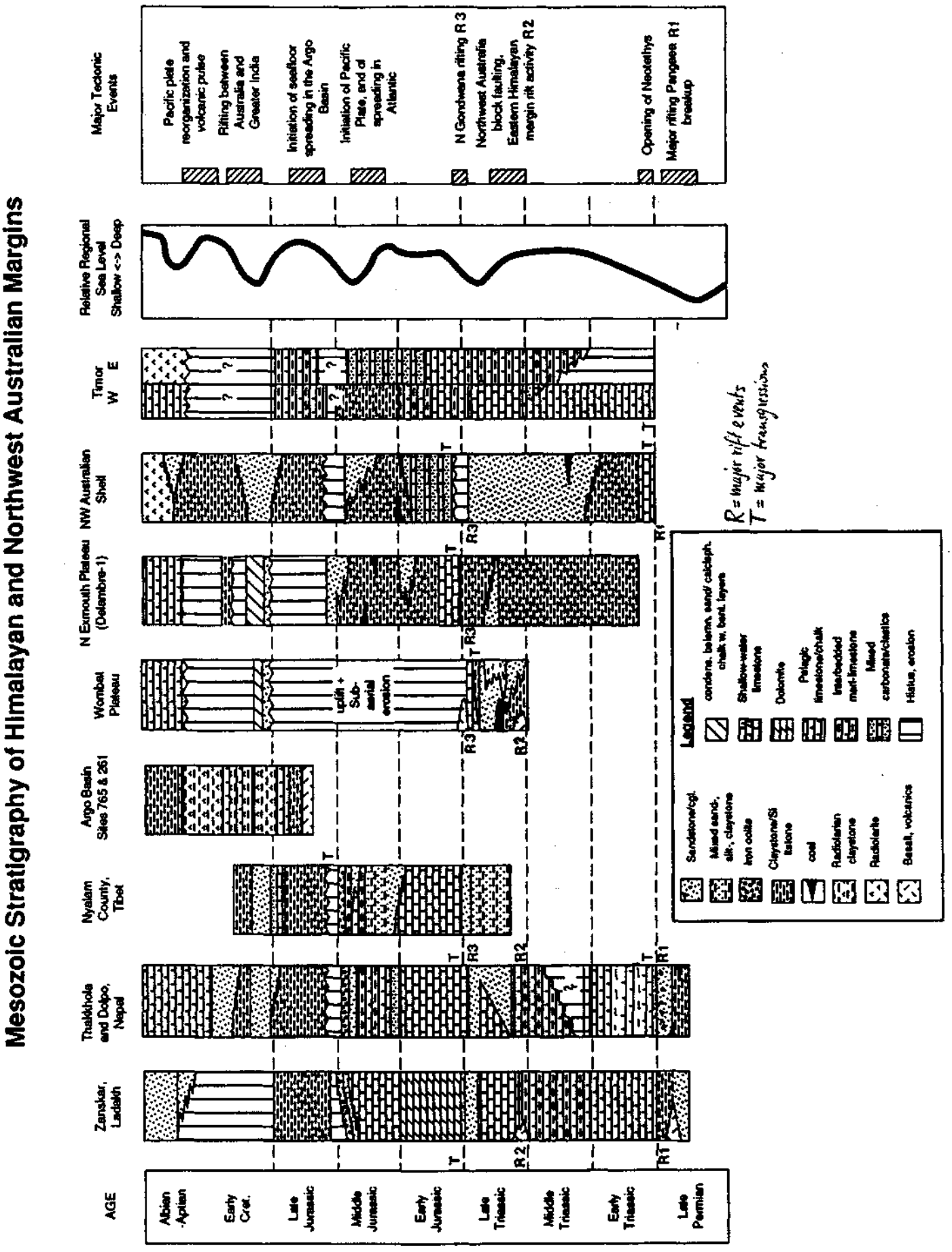
A sequence boundary of global significance ("215 Ma") was observed at Wombat Plateau: it is underlain by upper Norian fluviodeltaic floodplain to coal swamp deposits (highstand systems tract) and overlain by lower "Rhaetian" lagoonal marl/limestone cycles (transgressive systems tract) and upper Rhaetian reefal limestones (highstand systems tract). Tentatively, we correlate this major "215 Ma" sequence boundary to the top of the thick quartzitic marker bed of the lower Quartzite Formation, overlain by the shale- and carbonate-rich upper Quartzite Formation (transgressive systems tract).

A geohistory diagram of the Upper Permian to Jurassic strata in the Thakkhola shows the paleobathymetry, subsidence history and sedimentation rates. Global sea level was low in the late Permian and during Norian-Rhaetian time. Rapid tectonic subsidence after the late Permian rifting events caused substantial deepening of the margin to bathyal depths causing sediment starvation (Scythian to Carnian). Subsidence and sedimenta late Permian, Carnian and late Norian/"Rhaetian" times, whereas condensed sequences (< 1 m/Ma) and/or hiatuses straddle the Scythian to Ladinian stages. Apart from this unusual interval the burial curves indicate steady subsidence accentuated by rifting events, as typical for the early syn-rift history of passive margins.




Mesozoic Stratigraphy of Himalayan and Northwest Australian Margins
AGE
Albian -Aptian
Early Cret.
Late Jurassic
Middle Jurassic
Early Jurassic
Late Triassic
Middle Triassic
Early Triassic
Late Permian
Zanskar, Ladakh
Thakkhola and Dolpo, Nepal
Nyalam County, Tibet
Argo Basin Sites 765 & 261
Wombat Plateau
N Exmouth Plateau (Delambre-1)
NW Australian Shell
Timor W E
Relative Regional Sea Level Shallow <-> Deep
Major Tectonic Events
Pacific plate reorganization and volcanic pulse
Rifting between Australia and Greater India
Initiation of seafloor spreading in the Argo Basin
Initiation of Pacific Plate, and of spreading in Atlantic
N Gondwana rifting R3
Northwest Australia block faulting, Eastern Himalayan margin rift activity R2
Opening of Neotethys
Major rifting Pangaea R1 breakup
uplift + Sub-aerial erosion
R = major rift events
T = Major transgression
Legend
Sandstone/cgl.
Mixed sand, silt-, claystone
Iron oolite
Claystone/Si liatone
coal
Radiolarian claystone
Radiolarite
Basalt, volcanics
condens. bioclast. sand/ calciph. chalk w. bent. layers
Shallow-water limestone
Dolomite
Pelagic limestone/chalk
Interbedded mart-limestone
Mixed carbonate/clastics
Hiatus, erosion