

dropstones. Abundant cm- to tens of m-scale soft-sediment deformation suggests rapid deposition on water saturated substrates. Although these findings do not negate Carboniferous glaciation in Antarctica and the occurrence of a Permian ice sheet(s), they do indicate that glaciation was less widespread than previously hypothesized.

205-12 Poster Carlotto, Victor

LATE DEVONIAN GLACIATION IN THE NORTHERN CENTRAL ANDES: NEW EVIDENCE FROM SOUTHEAST PERU

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Keywords: Paleozoic; Glaciation; Gondwana; Andes

Late Devonian glacial marine deposits crop out in the Eastern Cordillera and Subandean of Peru, and in the Altiplano and Subandean of Bolivia. Palynological studies indicate a late Famennian age of the main glacial event in the region. The diamictite-bearing sequence overlies marine shales, reaches 100 m, and may be divided into three subunits. Basal laminated shales with dropstones are interpreted as the result of deposition from suspension and floating ice masses. A middle interval of massive diamictites with deformed sandstone lenses and large bedded sandstones is interpreted as proglacial sedimentation of nearby ice masses, with re-sedimentation due to gravitational processes. The upper part consists of quartzarenite beds displaying disharmonic folding, probably as a result of erosion and re-sedimentation of partially consolidated slabs. These beds include hummocky cross-stratification, indicating the primary deposition in a shallow-marine storm-dominated shelf environment, also affected by slumping and gravity flow in connection both with tectonic instability and high sea-level rates. In the southern area (Eastern Cordillera of Peru), deposition of the diamictite unit was controlled by lineaments trending NE-SW, probably linked to normal faults which were later reactivated as reverse faults by Andean tectonics. Bed-thickness and clast-size variations observed in the diamictites from the unit do not display an overall increase towards the top. Furthermore, paleoslopes indicate a sense of movement slumps and slides towards the NE. In the Bolivian northern Altiplano, similar structures yielded a NW-SE trend of lineaments controlling the geometry of the basin, with a middle interval of the NE and pronounced lineaments from the SW. The geomorphic setting is interpreted as a foreland basin in a retroarc position with regard to the Paleozoic magmatic arc developed along the active margin of western Gondwana. Uplift along this orogen favored local glaciation and the development from the unit to the next one, which is the epicontinental basin. Late Devonian glacial marine deposits in the northern Central Andes record an important regional glaciation in connection with the positioning of the western margin of Gondwana at mid-to-high latitudes. Similar features and deposits occur in other Gondwanan, South American, and African basins, demonstrating that a large part of Gondwana was affected by the late Famennian glacial event.

205-13 Poster Wang, Xiang-Dong

EXTINCTION AND RECOVERY OF REEFS DURING THE LATE DEVONIAN AND EARLY CARBONIFEROUS IN SOUTH CHINA

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Keywords: Reef evolution; F/F mass extinction; South China; metazoan reefs

Metazoan reefs flourished in South China during the Givetian when stromatoporoid sponges and both tabulate and rugose corals had a high diversity. More than 50 locations of Givetian metazoan reefs have been discovered in Hunan and Guangxi. However in the Frasnian, metazoan reefs declined markedly and only a few coral-sponge reefs remained at locations near the Yangtze and Chaoyang rivers in Hunan. In addition, some microbial reefs developed during the Frasnian at locations near Guilin, Guangxi. During the Famennian, metazoan reefs completely disappeared from South China although rugose corals and stromatoporoid sponges recovered shortly after during the Tabularian. No metazoan reefs appear in South China before the end of the Tournaesian. Although microbes were the dominant microbial reef formers, they did not build any reefs during the Tournaesian in South China, which differs from Western Europe where microbial Waulsortian reefs (or mounds) are present in Tournaesian strata. Metazoan reefs in which rugose corals and bryozoans became the main reef builders, as well as microbial reefs, did not appear again in South China until the Early Viséan. The decline of metazoan reefs during the Late Devonian and Early Carboniferous was possibly related to oxygen deficiency and the reduction of colonial organisms such as compound rugose corals, as compared with changes of total biodiversity. During the late Famennian, benthic organisms such as solitary rugose corals, stromatoporoid sponges, and brachiopods exhibited a rapid recovery, but no new genera of reefs appear in South China. After the F/F extinction event and only two genera remained in the Famennian. Although metazoan organisms recovered in the Early Viséan, the biodiversity had returned to the same level as that during the Givetian, colonial organisms like compound corals were still underdeveloped and metazoan reefs were still absent. At the end of the Tournaesian, the Tournaesian microbial reefs were replaced by a major diversification into 23 genera, metazoan reefs appeared again. The lack of colonial organisms during late Devonian and earliest Carboniferous was possibly related to a global cold climate.

205-14 Poster Maejima, Wataru

SEDIMENTATION AND BASIN EVOLUTION CONTROLLED BY DEGLACIATION: AN EXAMPLE FROM LATE CARBONIFEROUS TALCHIR FORMATION, TALCHIR GONDWANA BASIN, ORISSA, INDIA

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Keywords: basin evolution; deglacial control; Gondwana; Talchir Formation; sedimentary facies

The succession of the Talchir Formation, about 260 m thick, is tentatively subdivided into four lithostratigraphic units, namely A-I, A-II, B and C in ascending order. Unit A-I comprises mud-matrixed, very poorly sorted diamictites and interbedded thin sandstone and mudstone yielding dropstones. They reveal deposition in a proglacial lake environment in which ice rafting and

suspension sedimentation, as well as meltwater-underflow processes, produced variety of facies. Unit A-II is dominated by pebble to boulder conglomerates and sandstones. They were deposited mostly from various kinds of high-energy sediment gravity flows, both subaerial and subaqueous, and formed steep-faced fan-delta on the margin of the basin. Unit B demonstrates turbidite sedimentation in lake-margin slope and base-of-slope environments, in which a sublacustrine channel-fan system developed. Unit C dominantly consists of shale with intercalations of siltstone and sandstone and forms coarsening-upward deltaic sequence eventually covered by the fluvial deposits of the overlying Karharbari Formation. Following the glacial sedimentation, the Talchir succession shows a vertical facies progression suggesting gradual upward deepening of lake basin and eventual drainage of the basin. The sedimentary facies and successions represent deglacial control on basin evolution during the Talchir time. In the initial stage of glacial recession, a collapse of a glacier and a failure of montane glacial lakes frequently occurred and gave rise to generation of a highly sediment-laden turbidite flow and flood flow, which brought coarse clastics into the lake and built a fan-delta on the basin margin. The continued recession and disappearance of glacier resulted in eustatic sea-level rise and in abundant supply of ice-meltwater into the graben, being the cause of the rise in lake level. Accordingly the depositional environment switched from the lake margin slope and base of slope and then to the deep lake basin. Subsequent rapid delta progradation and eventual filling-up of the lake basin were likely due to forced sedimentation as a result of rapid lake-level fall. It was possibly caused by the regional uplift due to post-glacial isostatic rebound. The sediment dispersal pattern also changed in this stage; northerly lateral sediment supply switched to northerly axial supply, suggesting the establishment of an axial drainage system as a consequence of rapid draining of lake water through the graben.

205-15 Poster Di Pasquo, Mercedes

MISPORES FROM THE TARIJA FORMATION (UPPER CARBONIFEROUS) AT ZANJA HONDA CREEK (SALTA PROVINCE, ARGENTINA) AND ITS PALEOENVIRONMENTAL SIGNIFICANCE

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Keywords: Palynology; Sedimentology; Tarija Formation; Upper Carboniferous; Argentina

The Tarija Formation is the most representative unit of the Macharetí Group, covering from the eastern border of the Cordillera Oriental to the subsurface of the Littorua Chaco-Saltina of Salta province, Argentina. These deposits belong to the southern extension of the more extensive Tarija basin in the southern Bolivia and are related to the Carboniferous Gondwana glacial event. The aim of this contribution is to present new palynological data and their implication for basin evolution. The Tarija Formation (50 m thick) consists mainly of thick diamictites (Dm) interbedded with sandstone and mudstone layers. Fifty-six spore species, eighteen monosaccate and one preacolate pollen grains, four paleophytolankton species and many phytodebris except for charcoal particles are recorded from diamictitic levels in the middle-upper part of this unit at the Zanja Honda creek. The indigenous mispores are assigned to the middle part of the Dictyotriletes birtreticulatus-Cristatisporites chopacapanensis (BC) Biozone of Di Pasquo of early Late Carboniferous (Westphalian) age. Additionally, as in most of the Early Carboniferous samples of the basin, abundant reworked palynomorphs occur in both assemblages, recording erosion of Silurian to Early Carboniferous rocks. Some Late Carboniferous species such as *Striatospora kosankei* (Potonie & Kremp) Bhardwaj emend. Smith and Butterworth¹, *Cristatisporites* and *Cystosporites* are also present. The presence of the KA Biozone and *Raistrickia radiosa* Playford & Helby of the MS Biozone of Di Pasquo, are interpreted as reworked from lower Tupambi and Itacambi Formations. This evidence and the presence of thick successions of Dms facies suggest widespread erosion processes over older uplands during debris flows deposited in subaqueous paleoenvironments probably of continental origin supported by the presence of continental algae debris such as *Botryococcus braunii* Kützing and the facies associations. A hiatus between the fluvio-deltaic lacustrine Turic cycle ("Cycle I") and the fluvio-lacustrine lacustrine glacially influenced Itacambi - Tarija cycle ("Cycle II") is suggested by the palynologic and sedimentary data. This interpretation is confirmed by short ranged species with biostratigraphic value as well as by the recognition of lithological and palynological useful differences that helped for the characterization of both too similar superposed sedimentary cycles.

205-16 Poster Leman, Mohd Shafeea

EARLY PERMIAN CALCAREOUS SEQUENCE FROM THE SINGA FORMATION IN LANGKAWI, NORTHWEST PENINSULAR MALAYSIA: DEPOSITIONAL ENVIRONMENT AND PALAEOCLIMATIC IMPLICATION

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Keywords: Early Permian Limestone.; SIBUMASU block; Singa Formation; Malaysia

The Singa Formation in the Langkawi Island has been providing best evidence relating to the Permian of Peninsular Malaysia. The presence of the SIBUMASU block with other micro-continents in the late Paleozoic Cimmerian continents. The occurrences of marine glacial diamictites in this formation, supported by the presences of Early Permian cold-water brachiopod faunas were among those typical of the Turic Formation generally. The presence of thin bedded diamictites indicating sea level fluctuations, influenced by glaciation and deglaciation of the Gondwana supercontinent nearby. The deposition of the limestone should therefore represent a relatively quiet environment during the glacial period when a paucity of bryozoan is prominent. The quiet environment and the relative shallowing of the shelf due to the glaciation allowed some competent bryozoan and brachiopod species to thrive. In many cases, overlying these calcareous intervals are massive pebbly mudstones rich in Early Permian (late Asselian - late Artinskian) brachiopod faunas of strong Gondwanan affinity. The appearance of some transitional cold-temperate faunas in the upper part of the Singa Formation indicated that the SIBUMASU block possibly undergone a major deglaciation as early as late Sakmarian.

205-17 Poster Nyambe, Imasiku