Environmental and tectonic controls on the Norian-Jurassic sedimentary succession in the Northern Calcareous Alps (Stumpfmauer-Austria)

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The Upper Triassic-Jurassic succession of the Western Tethys was affected by major climatic and environmental changes, the end Triassic biotic crisis and Jurassic extensional tectonics related to the opening of the Alpine Tethys. These global and regional events are recorded in Norian-Upper Jurassic successions of the eastern Northern Calcareous Alps (Stumpfmauer, Austria), exposed in the Königsberg and Oisberg synclines. The transition from the Norian early-dolomitized peritidal facies of the Hauptdolomit to the Rhaetian mixed limestone-siliciclastic succession (Kössen Formation) marks a rapid siliciclastic input from the European hinterland, reflecting a switch from arid to humid climate. The studied sedimentary succession was divided from base to top in eight sedimentary units labelled from A to H. Unit A (40–50 m thick; upper Norian, Hochalm Member of the Kössen Formation) consists of peritidal facies organized in shallowing-upward cycles capped by subaerial exposures overlain by claystone beds, passing to a 50 m thick fossiliferous succession of claystone and marlstone, with phaceloid corals, bivalves and brachiopods (Unit B; uppermost Norian-lowermost Rhaetian, Hochalm Member). Unit C (10 m thick, lower Rhaetian, Hochalm Member) corresponds to a massive coral limestone, representing a regional marker bed. Unit C is overlain by shallow-marine skeletal peloidal packstone/wackestone and coated-grain grainstone forming subtidal, shallowing-upward cyclothems capped by subaerial exposures followed by claystone (Unit D, 80–110 m thick, middle to upper Rhaetian; Upper Rhaetian Limestone time-equivalent to Eiberg Member of the Kössen Formation). Unit E is characterized by a basal transgressive lag with crinoidal lithoclastic rudstone overlain by nearly 45 m thick progradational cross-bedded high-energy coated grain-ooidal grainstone (Upper Rhaetian Limestone time equivalent to Eiberg Member). Unit F records a sharp change in deposition with 40 m of bivalve and ostracod wackestone/floatstone overlain by microbial boundstone with Cayeuxia associated with peloidal packstone/grainstone, likely reflecting the extinction event close to the Triassic-Jurassic boundary. Unit G (34 m thick, lower Jurassic, Kalksburg Fm.) consists of cross-laminated crinoidal coated grain grainstone with detrital quartz, passing upward to deep pelagic red colour crinoidal, thin-shelled bivalves packstone/rudstone with ammonites and radiolaria wackestone, suggesting the drowning of the shelf (Unit H, Lower to Upper Jurassic, Hierlatz Member, Adnet, Klaus, Ruhpolding formations).

The Königsberg and Oisberg synclines show different stratigraphic evolution: in the Königsberg syncline the succession is continuous from Unit A to H, whereas in the Oisberg syncline Unit A is sharply overlain by Unit H Middle Jurassic limestone. The existence of this Rhaetian-Lower Jurassic stratigraphic gap in the Oisberg syncline suggests local uplift and erosion of the Rhaetian succession before the regional Middle Jurassic drowning, whereas sedimentation persisted in nearby areas.

The investigated sedimentary evolution and facies distribution reflect a major climate change (Kössen Formation) followed by early-middle Jurassic extensional tectonics driven by the opening of the Alpine Tethys, controlling the formation of structural highs, where part of the Rhaetian succession was eroded, and lows where the succession was continuous. The observed stratigraphic setting can be framed in the regional evolution of the Alpine Tethys, which can be traced in the different palaeogeographic domains of the Alps.

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