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Age constraints, sedimentology, and tectonics from a well bedded sequence of Feuerstätter Sandstein south of Balderschwang, Allgäu Alps, Bavaria

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The majority of the outcrops of the alpine Feuerstätter Sandstein in southwestern Bavaria and Vorarlberg (Austria) suggests rather massive, homogeneous, more or less glauconite-containing sandstone bodies than well bedded sequences. Normally, the up to 50 m thick Feuerstätter Sandstein formation is characterized by the absence of datable material, massive brittle tectonic deformation and recent mass movements. In contrast, an unusually well bedded sequence of Feuerstätter Sandstein is exposed in the Lappach valley south of the village of Balderschwang, lining the border between Bavaria and Vorarlberg. This specific sandstone succession contains several thin marly intercalations from which samples have been collected recently.

Calcareous nannoplancton dating of these marl samples provides an upper Middle-Eocene depositional age which is the youngest age reported for the Feuerstätter Sandstein. The sequence of the quartz sandstone of the Lappach succession including the marly layers is tectonically undisturbed. The beds dip northwards, steeply inclined at the bottom (85°) and moderately in the uppermost part (40°) of the sequence. The sandstone beds of the main part of the complex reveal mostly layers which are 0.1 to 0.7 m thick. In contrast, the uppermost beds exposed within the sequence show an increasing thickness of 2.5 to 4.5 m. A variety of different sedimentary structures occur in individual beds of the lower part: graded bedding, varying grain sizes, different amounts of glauconite, local occurrence of feldspar clasts, fine lamination and N–S striking channel structures at the bottom of certain sandstone layers. Within the uppermost exposed particularly thick and poorly to unsorted deposits of the sequence coarser grain sizes occur, containing even small quartz pebbles.

The continuous development from the well bedded and fine grained basal layers towards the massive and coarser grained sandstone deposits at the top suggests sedimentation from a distal to a proximal position in a submarine fan, reflecting an increase of energy within the deposits. Sedimentary structures and northwards inclined beds suggest sediment transport from south to north. Additionally, a syn-sedimentary northward tilting of the base of the sedimentary succession during deposition cannot be excluded.

Origin of the deposited sands is most likely a diversified coastal realm providing sand material of various stages of maturity and composition. Among instabilities of sand masses near the coast, frequent seismic activities can be assumed to have triggered the individual events of deposition observed in the Lappach valley sandstone succession, most likely driven by actively prograding tectonic nappes in the south.