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Grainstones and cementstone mounds: The Trogkofel summit section (Lower Permian, Carnic Alps, Austria).

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In the Carnic Alps, Austria, an Artinskian succession 400 m thick of shallow-water bioclastic limestones and of mounds composed of ?Archaeolithophyllum, Archaeolithoporella and abundant fibrous cementstone (after former aragonite) records deposition along a "grainstone-dominated" platform margin.
The section was taken along the route through the east-facing cliff of Trogkofel. The Trogkofel Limestone (Artinskian pro parte) is excellently exposed and preserved the most complete along this route, but no section has hitherto been logged. The total thickness of the Trogkofel Limestone probably is about 550 meters; the summit section comprises its upper 400 meters. The section consists mainly of shallow-water bioclastic limestones (grainstones, packstones, rudstones) intercalated with cementstone mounds. Both the bioclastic limestones and the mounds typically are thick-bedded to, more commonly, unbedded. Throughout the section, intervals a few tens of meters in thickness dominated by bioclastic limestones change vertically with intervals dominated by cementstone mounds. Up-section, no clear-cut trend with respect to prevalent facies, mean depositional water depth, and energy index is obvious. Furthermore, no lime-muddy, meter-scale peritidal cycles, and no teepee structures and no pisolite levels were identified; thin intervals of fenestral lime mudstones and/or of cryptmicrobially-laminated limestones are very rare. The bioclastic limestones commonly weather out unstratified, or show subhorizontal stratification or, more rarely, low-angle cross-stratification. In the upper 100 meters of section, grainstones to fine-grained rudstones rich in keystone vugs are prevalent. The cementstone mounds comprise intervals up to a few meters in thickness; the biogenic component is characterized by foliose crusts pertaining to ?Archaeolithophyllum hidensis and Archaeolithoporella, overgrown by Tubiphytes and fenestrate bryozoans. The ?Archaeolithophyllum-Archaeolithoporella crusts are overgrown by abundant, thick fringes and botryoids of fibrous cement that is interpreted as calcitized aragonite cement. In addition, brachiopods, crustose red algae, and a few solitary and colonial rugose corals are typical. By volume, the former aragonite cement comprises the majority of the mounds. Intrinsic pores within the cementstone fabrics typically are filled by micropeloidal grainstone and/or by lime mudstone. The Trogkofel Limestone is locally dolomitized. Replacement dolomites show a wide range of crystal shapes and textures, but overall comprise (a) finely-crystalline, limpid dolostone of xenotopic or hypidiotopic fabrics that broadly mimick the texture of replaced sediment and cements, (b) coarse-crystalline fabrics of hypidiotopic to idiotopic, limpid or optically zoned dolomite, and (c) replacement saddle dolomite.
The Trogkofel Limestone is riddled by karstic dykes and caverns that are mainly filled by, both or either of, geopetally-laminated red lime mudstone, terrigenous red sandstones, or thick fringes of fibrous cement. In the karstic cavity fills, packages of convolute geopetal lamination and brecciated internal sediments (internal seismites) overlain by infills with non-convolute lamination, fracture of fibrous cements, and dykes filled by multi-phase fracture breccias record tectonism during or after deposition of the Trogkofel Limestone. The Trogkofel Limestone is capped by a truncation surface which, in turn, is overlain by an interval of extremely poorly sorted, thick-bedded breccias with a former matrix of lime mudstone ("Trogkofel Breccia"). Both the components and the matrix of the Trogkofel Breccia are dolomitized.
We interpret the facies and facies architecture of the eastern cliff section of Trogkofel as succession from the seaward side of a "grainstone-dominated" platform margin with cementstone mounds. The lack of clear-cut vertical trends in prevalent facies suggests that the platform margin developed mainly by aggradation. The timing and processes of replacement dolomitization(s) to date are poorly constrained. The presence of saddle dolomite nevertheless indicates passage of dolomitizing fluids of more than 90-100°C.