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Enigmatic traces of volcanism in the Rhaetian of a far-travelled Late Triassic Hallstatt nappe in northern Montenegro

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In northern Montenegro on the road east of Gradac in direction to Šula a more than 120 m thick overturned Late Triassic succession of bedded Early Norian to Rhaetian siliceous hemipelagic limestones is exposed above Early Norian fore-reef Dachstein limestones. This section is part of a far-travelled nappe stack deriving from the stacked and overriden Hallstatt shelf by obducting Neo-Tethys ophiolites. The Hallstatt nappes in northern Montenegro were bulldozed in Middle-Late Jurassic times by the ophiolites to the west and rest today as outliers on top of the East Bosnian-Durmitor megaunit (Outer Dinarides).
The section starts with a roughly 20 m-thick reef to fore-reef limestone succession with deep-water matrix in the upper part (Lacian 2 in age according to conodonts). Near the base the reef limestone is thick bedded to massive, higher up in the section variously bedded. We consider these fore-reef limestones as part of the Dachstein Reef Limestone, interestingly with a deepening upward sequence from the middle Lower Norian onwards. Around the Lacian 2-3 boundary the depositional characteristics changes relatively abrupt. The upsection following 30 m-thick dm-bedded grey-reddish limestones contain chert nodules and layers. Conodont dating shows that the age of this part of the section is Lacian 3 to Alaunian 3 in the upper part. The higher Alaunian 3 to Sevatian is characterized by a thick series of slump deposits with carbonate turbidite intercalations. In these slumps, mainly grey siliceous thin-bedded limestones of the higher Alaunian, appear polymictic breccias (debris flows) and turbiditic microbreccias with older (Lacian and Alaunian) hemipelagic components. The overlying dm-bedded grey-reddish siliceous limestones with red chert nodules are of Rhaetian age dated with the appearance of *Misikella posthernsteini*. In these reddish-grey limestones also slump deposits are common. The diagenetic overprint of the whole sequence is low as proven by low Conodont Colour Alteration Index (CAI) values of CAI >1.0.
In the lowermost part of the Rhaetian grey siliceous limestones above the slump horizon occur yellowish siliceous marls with a high amount of clay minerals of the mica group but also with a remarkable amount of mixed-layer clay minerals which point to deposition of most probably far-transported (wind-blown) volcanic ashes. Such volcanic ashes are so far also not proven in the ALCAPA region, where marly sediments (Zlambach marls and equivalents) replace in the Rhaetian the formation of open-marine limestones on the Hallstatt shelf. In contrast, in the Dinarides such marls are not known and deposition of siliceous limestones continues. Only deposits indicating intense tectonic motions like Mass Transport Deposits or slumpings are age equivalent in both palaeogeographic different domains. Beside the direct biostratigraphic age dating, event deposits, the deposition of volcanic ashes around the Norian/Rhaetian boundary can be an indicative lithostratigraphic marker. Intense volcanic activity is known from northern Peru or the Canadian Cordillera, where the Norian/Rhaetian boundary was dated precisely by zircons.

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