Timing and global manifestations of the Carnian Crisis, Late Triassic

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The mid-Carnian (~233 Ma) is a time of major climatic changes in the Late Triassic. We investigated sections in the Northern Calcareous Alps (NCA), Indian Himalaya, Oman and South China to reveal the nature of environmental perturbations in a global context. In the Scheiblingsgraben section of the NCA, the Carnian Humid Episode (CHE) is marked by the disappearance of reef-derived debris in the Reifling Limestone (and Raming L. of coeval sections) and a transition to thin lime laminites of the Göstling Member in the latest Julian 1, accompanied by a prominent negative shift in $\delta^{13}C_{carb}$ from 2.6 to 0.4 ‰. This transition is followed by the onset of intense anoxia and a carbonate production crisis above the Julian 1-Julian 2 boundary, evidenced by the development of fine laminated black paper shales (Reingraben Shales) on top of the Göstling silty carbonates. In contrast to the intra-platform Reifling Basin setting of Scheiblingsgraben, anoxic facies and carbonate production crisis were not recorded in the condensed, open-marine Hallstatt facies at Feuerkogel, NCA. Instead, the distinct reddish Hallstatt limestones with diverse faunas suggest a fully oxygenated environment from the late Ladinian to the early Norian. In the Spiti Valley of the Indian Himalaya, carbonate deposition of Chomule Fm also ceased below the Julian 1-Julian 2 boundary and was followed by dark grey shales and phosphate-bearing black paper shales of the Rama Fm, indicating a transition from oxic-dysoxic to dysoxic-anoxic conditions. The CHE in the Nanpanjiang Basin of South China coincides with the transition from the hemipelagic nodular limestones of the Zhuganpo Fm to the Wayao black shales. The onset of basin-wide anoxia-euxinia in South China was coeval with that seen in the Scheiblingsgraben section, NCA but was long-lasting, persisting to at least the Tuvalian 2. In the Wadi Mayhah section of northern Oman, the carbonate production was weakened, but not fully suspended during the CHE, evidenced by a transition from the cherty carbonates in Julian 1 to a carbonate and shale combination in the Julian 2. Clearly evidence for anoxia is absent at Wadi Mayhah. Thus both carbonate production crisis and oceanic anoxia were geographically widespread in the mid-Carnian, but with large regional variations in duration and intensity, and are not recorded in all sections. Large negative $\delta^{13}C_{carb}$ perturbations are documented in all studied sections, suggesting that large amount of light carbon input might be one of the important triggers of the Carnian crisis. Differences in timing and manifestations of the CHE were probably controlled, at least partially, by regional oceanographic settings.