# Ammonoid evolution and early warning signs for global warming during the end-Permian mass extinction

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## Programme and Abstracts

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from the mobilisation of permafrost carbon from flooded shelves alone, while only little of the observed decrease in $\Delta^{14}$Catm can be explained. This process together with deglacial inland permafrost degradation might thus have contributed significantly to the rapid increases in $CO_2$atm during the last deglaciation.

**TP5-O-20**

### Ammonoid evolution and early warning signs for global warming during the end-Permian mass extinction

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The devastating end-Permian mass extinction (252 my ago) is regarded as the most severe biotic crisis of the last 500 million years. Profound and rapid greenhouse gas release by Siberian magmatism led to a tropical seawater temperature increase of eight to ten degrees led to a complete reworking of the biosphere (e.g. Joachimski et al. 2012; Schobben et al. 2014). Heating, loss of oxygen in seawater, and ocean acidification are thought to have caused the extinction of ca. 90% of marine animal species in a protracted time interval of perhaps less than 1,000 years. We challenge the view of a single extinction pulse, based on the latest Permian ammonoid record in Iran. Contrary to other parts of the world, this critical time interval is completely represented in the Julfa and Abadeh areas of Iran. Statistical analyses of stratigraphic confidence intervals led us to identify extinction pulses before the traditionally identified extinction horizon. In addition, the body size of ammonoids declined by orders of magnitude over the last 0.7 my years of the Permian period. Similar pre-mass extinction declines and disturbances of the carbon cycle have sometimes been reported from other regions, suggesting a widespread, but often overlooked environmental deterioration at a global scale, well before the traditional main extinction event (Kiessling et al. 2018). Ammonoids may thus help in the detection of environmental stresses that eventually led to the collapse of the marine palaeocommunities.

Joachimski, M.M., X. Lai, S. Shen, H. Jiang, G. Luo, B. Chen, J. Chen, and Y. Sun. 2012. Climate warming in the latest Permian and the Permian–Triassic mass extinction. Geology 40 (3): 195-198. Kiessling, W., M. Schobben, A. Ghaderi, V. Hairapetian, L. Leda, and D. Korn. 2018. Pre–mass extinction decline of latest Permian ammonoids. Geology 46 (3):283-286. Schobben, M., M.M. Joachimski, D. Korn, L. Leda, and C. Korte. 2014. Palaeotethys seawater temperature rise and an intensified hydrological cycle following the end-Permian mass extinction. Gondwana Research 26: 675-683.

**TP5-O-21**

### Extreme events of perceived temperature over Europe in the future: the humidity role.

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An increase of 2 m temperature over Europe is expected within the current century. In order to consider health impacts, it is important to evaluate the combined effect of temperature and humidity on the human body. To this aim, projections of a basic index – the humidex - representative of the perceived temperature, under different scenarios and periods, have been investigated based on a EURO-CORDEX high resolution multi-model approach. Projected extreme perceived temperature patterns are different from what we expect in terms of temperature only, mainly due to the humidity role.

**TP5-O-22**

### The extreme summer 2018 in Sweden – in historical and future context

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The summer 2018 in Sweden and northern Europe has been exceptional warm, dry, and long. Historical observations in Stockholm reveal that May to August 2018 was unique in a 263-year perspective. The most extreme aspect of the extended heat wave across Sweden was its length and the number of warm days. The impact of heat and drought was felt throughout many parts of the society. Groundwater shortage, many extensive forest fires (requiring assistance on European scale), health impacts on people, drought related shortage of food for livestock leading to emergency slaughter in many regions. Here we want to describe the meteorological situation during the heat and drought event. Furthermore, we set it into context of past events and even give a possible view for the future, considering different future scenarios. Three grant ensembles of climate models, additionally to the CMIP5 ensemble, will support the probability analysis of such kind of event in the future as well as underlining the differences to the past climate.