Ber. Inst. Erdwiss. K.-F.-Univ. Graz	ISSN 1608-8166	Band 16	Graz 2011
IGCP 596 Opening Meeting	Graz, 19-24th September 2011		

Late Devonian conodonts and isotope geochemistry, northwestern Thailand

SAVAGE, N.M.[1], LUTAT, P.[2], SARDSUD, A.[3], KÖNIGSHOF, P.[4], RACKI, G.[5], DOPIERALSKA, J.[6] & BELKA, Z.[6]

(1) Department of Geological Sciences, University of Oregon, Eugene Oregon 97405, USA; *nmsavage@uoregon.edu*
(2) Palaeontological Research Centre, Mahasarakham University, Mahasarakham 44150, Thailand; *Petra.l@msu.ac.th*
(3) Department of Mineral Resources, Geological Survey Division, Bangkok 10400, Thailand; *apsornsa@yahoo.com*
(4) Senckenberg Naturmuseum, 60325 Frankfurt am Main, Germany; *Peter.Koenigshof@senckenberg.de*
(5) Department of Earth Sciences, Silesian University, 41-200 Sosnowiec, Poland; *racki@us.edu.pl*
(6) Isotope Laboratory, Adam Mickiewicz University, PL61606, Poznam, Poland; *dopieralska@amu.edu.pl*; *zbelka@amu.edu.pl*

A roadside section near Thong Pha Phum, northwestern Thailand, includes the Upper Kellwasser event and probably also includes the upper part of the Lower Kellwasser event. Stable isotope geochemistry for this interval shows a positive $\delta^{13}C$ excursion in the Late *rhenana* conodont Zone followed by a gradual return to normal, followed by a sudden positive excursion near the conodont extinction event.

About 350 km farther north, a near-vertical section almost eleven metres thick near the town of Mae Sariang, northwestern Thailand, has yielded conodont faunas of late Frasnian to late Famennian age. The section appears to include the Lower and Upper Kellwasser, Enkeberg, and the lower part of the Hangenberg events, as indicated by the conodonts and $\delta^{13}C$ isotope excursions. The faunas are mostly cosmopolitan but include several new species. The $\delta^{18}O$ isotope data are unreliable because of diagenetic overprint.

The 80 conodont faunas from Mae Sariang suggest the presence of the Late *rhenana*, *linguiformis*, *triangularis*, *crepida*, *rhomboidea*, *marginifera*, *trachytera*, *postera*, *expansa*, and *praesulcata* zones. The $\delta^{13}C$ pattern closely resembles the global carbon isotope pattern of BUGGISCH & JOACHIMSKI (2006). In the *linguiformis* Zone the $\delta^{13}C$ isotope data have values less than 0.9 but there are major positive spikes to between 3.0 and 4.0 during the Late *rhenana* and Early *triangularis* zones. In the succeeding samples the ^{13}C values fluctuate with a general trend down to about 2.1 but with a positive spike to 3.1 in the Middle *marginifera* Zone and an increase to approximately 2.8 during what is thought to be the lower and middle *praesulcata* zones near the top of the section.

An outer shelf, starved basin setting is probable. A microfacies study of the section (see contribution by KÖNIGSHOF *et al*., this meeting) indicates the well-bedded limestones are condensed with some sedimentary interruptions and hardgrounds.

An examination of the geochemistry of the Mae Sariang marine late Frasnian to latest Famennian site should take account of the increasing terrestrial vegetation during the Devonian. The input of fresh water from the continents had occurred for billions of years prior to the Devonian but the water had flowed mostly from bare soil. Some spore-bearing vegetation was present in moist and mostly low-lying areas in Late Ordovician, Silurian, and Early Devonian times but it was the advent of pollen-bearing conifers that lead to the greening on the continents during the Late Devonian. These coniferous plants made decomposing organic material in the soil a factor in the geochemical content of water flowing into the oceans.

Some paleontologists have invoked ocean-floor volcanic hydrothermal release of iron, phosphorus, sulfur, nitrogen, and trace elements as sources of eutrophic nutrients. They note the abundance of silica-rich radiolarian cherts in the dark anoxic shales that characterize Late Devonian and other extinctions. Anoxic shales are not present in the Mae Sariang section, nor are they present in the Late Frasnian to early Famennian section 350 km south at Thong Pha Phum (SAVAGE *et al*. 2006).

There is some evidence of volcanic input at Mae Sariang but mostly during Upper Kellwasser time. There is also evidence of some hydrothermal activity in the sediments during most of the Famennian,

and especially towards the latest Famennian. In the Mae Sariang sedimentation the near-bottom seawater was mostly oxic, with anoxia only notable during the Upper Kellwasser and Enkeberg intervals. Cool water contains far more oxygen than warm water, being twice as great at 10℃ as at 20℃. Rising cool water and conditions of high phos phorus, barium, vanadium and molybdenum input could have caused high algal blooms leading to excessive bacteria, radiolarians, and multiplication up the animal food-chain. These organisms could ultimately deplete the algae and use much of the available oxygen causing "dead zone" conditions, well-known at today's ocean margins. This eutrophication cycle may have resulted in anoxia during Upper Kellwasser and Enkeberg times.

References

BUGGISCH, W. & JOACHIMSKI, M.M. (2006): Carbon isotope stratigraphy of the Devonian of Central and Southern Europe. - Palaeogeography, Palaeoclimatology, Palaeoecology, 240: 68-88.

SAVAGE, N.M., SARDSUD, A. & BUGGISCH, W. (2006): Late Devonian conodonts and the global Frasnian-Famennian extinction event. - Palaeoworld 15: 171-184.