

Vertebrate Isotopes and the Environment (VISE)



VISE seeks to test and develop our understanding of the relationship between the isotopic composition of sea water and vertebrate tissues (shark teeth and teleost otoliths), in particular, oxygen isotopic ratios which are thought to act as a proxy for the temperature of the seawater the organism lived in. VISE is also addressing the record of oxygen isotopes in conodonts to better understand their palaeoecology and use in Palaeozoic seawater temperature reconstructions.

Shark teeth, reasonably common in the fossil record over the past 400 million years, have been used extensively in isotopic studies as a consequence of the 'conveyor belt' production of individual teeth within a shark's mouth during their life cycle and their high preservation potential. In collaboration with the Sea Life Centre network, the research team are analysing the teeth of a wide range of sharks and the tank waters in which they are housed to establish the reliability of shark teeth isotopic ratios as a proxy for seawater chemistry, and, importantly, look for any evidence of self fractionation within sharks. Previously, this field of research has been validated on the basis of wild caught specimens with little control on which body of water the individual sharks were in when they were mineralising their teeth. The study team will also conduct a series of taphonomic and processing experiments to see if the fossilisation and standard palaeontological processing methods adversely influence tooth composition.

Otoliths, the aragonitic inner ear 'stones' of fish, are also being analysed from a range of species. The variability in the isotopic composition of otoliths is widely used to identify the life-history dynamics of many different types of fish in the natural environment, and in the case of oxygen, to estimate temperature and palaeotemperatures of seawater masses. Otoliths are relatively common in some parts of the fossil record, particularly in the Jurassic and the Cretaceous, yet are under-utilised in isotope studies. Inter-taxon oxygen isotope variability is recognized, but the extent of this from a variety of taxa in the context of a constrained marine setting is poorly resolved.

Our current conodont work is focussed on Ordovician (Newfoundland), Silurian (UK) and Permian and Triassic (Greenland) material. Species isotopic variability in conodonts is starting to demonstrate the potential for reconstructing ancient water mass configurations. The work is also revealing the influence of processing and post-mortem effects on conodont oxygen isotopes.

Oxygen isotopes are analysed via ion microprobe and through our SILLA lab at the University of Birmingham.

Members of staff involved:

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Project funding:

Sansom, I.J. and Wheeley, J.R. 2012. Oxygen isotopes in shark teeth: testing for intra-tooth variability and the impact of processing methods. NERC Ion Microprobe Facility IMF470/1012 (£11,250).

Smith, M.P., Wheeley, J.R. and Boomer, I. 2011. *Constraining conodont $\delta^{18}\text{O}$ for marine palaeothermometry*. NERC IMF414/1010 (~£22,500).

Žigaitė, Ž. and Sansom, I.J., Wheeley, J.R., Boomer, I., Smith, M.P. 2011. *VISE: Vertebrate Isotopes and the Environment*. Marie Curie Intra-European Fellowship for Zivile Žigaite (£148,924).

Wheeley, J.R. 2010. *Deciphering Paleozoic paleoenvironmental changes using stable and radiogenic isotope proxies. GEES funding for attending and organizing technical session at The Annual Meeting of the Geological Society of America, Denver, Colorado, 2010 (£1,600)*. GEES funding for attending and organizing technical session at The Annual Meeting of the Geological Society of America, Denver, Colorado, 2010 (£1,600).

Wheeley, J.R. 2010. Nitrogen and organic carbon isotopes for conodont palaeoecology. The Palaeontological Association Research Grant (£3,500).

Wheeley, J.R. and Smith, M.P. 2010. Nitrogen and organic carbon isotopes in early vertebrate hard tissues – elucidating the trophic position and life modes of vertebrates in Ordovician ecosystems. Royal Society Research Grant (£14,015).

Wheeley, J.R., Smith, M.P. and Boomer, I. 2009. Oxygen isotopes from conodont phosphate. NERC Isotope Geoscience Laboratories (NIGL) (~£500 in kind from NIGL).

Smith, M.P., Wheeley, J.R., Boomer, I. 2008. Conodonts as palaeotemperature indicators in Palaeozoic oceans? A proof-of-concept study. NERC IMF333/0508 (~£6,250).

Publications, reports, conference abstracts:

Wheeley, J.R., Smith, M.P. and Boomer, I. 2013. Oxygen isotope variability in Ordovician and Silurian conodonts. NAMS (North American Micropaleontology Society) 3. Houston, Texas.

Wheeley, J.R., Smith, M.P. and Boomer, I. 2012. Oxygen isotope variability in conodonts: implications for reconstructing Palaeozoic palaeoclimates and palaeoceanography. *Journal of the Geological Society, London*, 169: 239-250.

Wheeley, J.R., Smith, M.P. and Boomer, I. 2012. $\delta^{18}\text{O}$ variability in Ordovician and Silurian conodonts: implications for Palaeozoic palaeoclimates. The Micropalaeontological Association Annual Meeting.

Wheeley, J.R., Smith, M.P. and Boomer, I. 2010. Assessing the utility of ion microprobe analyses of conodont isotopes for ancient ocean palaeothermometry. GSA Denver, Colorado. Geological Society of America Abstracts with Programs, Vol. 42, No. 5, p. 514.
http://gsa.confex.com/gsa/2010AM/finalprogram/session_26338.htm (http://gsa.confex.com/gsa/2010AM/finalprogram/session_26338.htm)

Wheeley, J.R., Smith, M.P. and Boomer, I. 2010. Conodonts as palaeothermometers in ancient oceans: tests and limitations. Third International Palaeontological Congress, London. Symposium: The Micropalaeontological Record of Global Change. Programme and Abstracts p. 409.

Wheeley, J.R., Smith, M.P. and Boomer, I. 2009. Conodonts as palaeothermometers of ancient oceans? Palaeontological Association 53rd Annual Meeting. *Palaeontology Newsletter*, 72: 36..

Key periods of data collection/fieldwork activity:

2008 to present

Opportunities (e.g. PhD proposals):

We are always interested in hearing from potential PhD applicants in the field of vertebrate isotopes. Email i.j.sansom@bham.ac.uk (<mailto:i.j.sansom@bham.ac.uk>) or j.r.wheeley@bham.ac.uk (<mailto:j.r.wheeley@bham.ac.uk>) if you are in the position to apply for a research position in this area.