Supplementary Material

Subaerial speleothems and deep karst in central Sweden linked to Hirnantian glaciations – $^{87}Sr/^{86}Sr$ isotope ratio of selected brachiopod shells, and results of Energy-dispersive-X-ray spectroscopy

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1. $^{87}Sr/^{86}Sr$ isotope ratio of selected brachiopod shells

The stratigraphic position, additionally, was tested with the $^{87}Sr/^{86}Sr$ isotope ratio of selected brachiopod shells (Table 1). The isotope ratios of marine shells of Hirnantian age should be between 0.707945–0.707868, slightly higher than Katian ratios, and lower than Silurian ratios (LOWESS 5 skeleton dataset, McArthur et al., 2012). Our values, obtained from brachiopod shells from Hirnantian beds of Osmundsberget, Kallholn and Solberga, are consistently much higher than expected (Table 3). This is probably a result of early diagenetic overprint and influence of meteoric water (compare Brand, 1991).

2. Results Energy-dispersive-X-ray spectroscopy (EDS) of the speleothems

A semiquantitative EDS of a sample S1B (same see in main paper, Table 2) from the laminated, peloidal grainstone (stromatolite-like speleothem) of the Solberga quarry was taken. The sample was Au coated for scan microscopy. The result indicates the presence of low Mg-Calcite in the micrite of the speleothem (Fig. 1).

REFERENCES CITED

Brand, U., 1991, Strontium isotope diagenesis of biogenic aragonite and low-Mg calcite: Geochimica et Cosmochimica Acta v. 55, p. 505–513.

McArthur, J.M., Howarth, R.J., and Shields, G.A., 2012, Strontium Isotope Stratigraphy: The Geologic Time Scale 2012. Edited by Gradstein, F.M., Ogg, J.G., Schmitz, M., and Ogg, G., Elsevier, New York, p. 127–144.

Table 1. List of results of $^{87}Sr/^{86}Sr$ ratios from brachiopod shells within the Boda Limestone (UB Mbr., Upper Boda Member; BC Mbr., Boda Core Member) and the overlying Glisstjärn Formation (Glisst. Fm).; Kallholn = Kallholn southern entrance wall of Suzuki et al. (2009), Osmundsberget localities = Osmundsberget 1, 4, 5 of Ebbestad and Högström (2007); Solberga south wall: N60°58'57.3", E015°13'00.8"= locality Solberga 2 of Ebbestad and Högström (2007). Data was obtained using a Thermal Ionization Mass Spectrometer (TIMS).

Sample	**Taxon**	**Locality**	$^{87}Sr/^{86}Sr$ **ratio**	**Stratigraphy**
10	*Hindella*	Osmundsberget 1	0,707968	BC Mbr, Katian
02	*Brevilamnulella kjerulfi* ?	Kallholn	0,708847	UB Mbr, Hirnantian
03	*Brevilamnulella kjerulfi*	Kallholn	0,708175	UB Mbr, Hirnantian
04	*Clorilamnulella* ? sp.	Kallholn	0,708361	UB Mbr, Hirnantian
07	*Brevilamnulella kjerulfi* ?	Kallholn	0,708168	UB Mbr, Hirnantian
09	*Clorilamnulella osmundsbergensis*	Osmundsberget 1	0,708199	UB Mbr, Hirnantian
05	*Brevilamnulella kjerulfi*	Osmundsberget 5	0,708416	UB Mbr, Hirnantian
08	*Brevilamnulella kjerulfi*	Osmundsberget 1	0,708466	UB Mbr, Hirnantian
06	*Brevilamnulella umbosulcata*	Solberga, south wall	0,708080	UB Mbr, Hirnantian

Sample	Taxon	Locality	$^{87}Sr/^{86}Sr$ ratio	Stratigraphy
11	*Brevilamnulella umbosulcata*	Solberga, south wall	0,708027	UB Mbr, Hirnantian
01	Brachiopoda *indet.*	Solberga, south wall	0,708556	fissure filling, Silurian? marl
12	*Chlorilamnulella osmundsbergensis*	Osmundsberget 1	0,708428	Glisst. Fm, Hirnantian

Figure 1. Results of the EDS analysis of sample S1B from Solberga quarry, south wall, fissure crust. Note the elevated Au values, which are a result from the coating of the sample.

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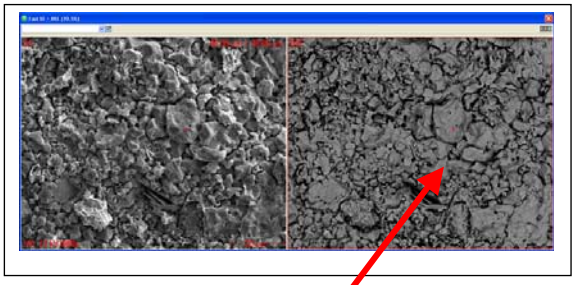
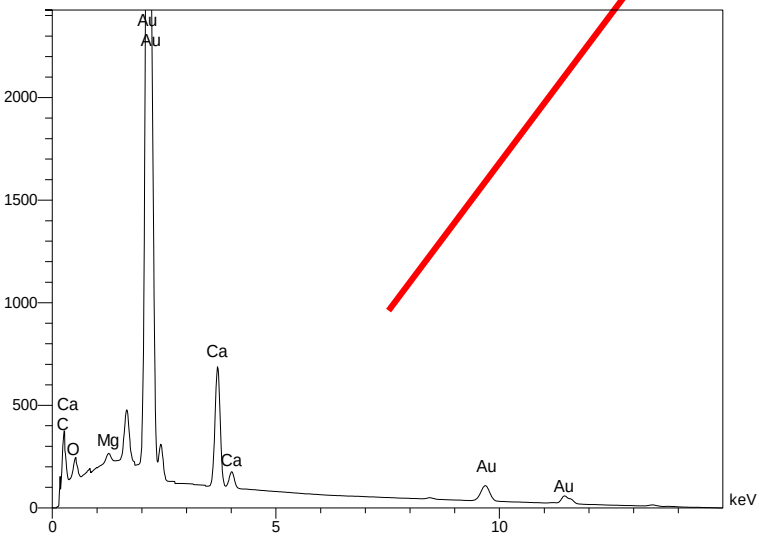
Sample:

Electron microprobe	Jeol Superprobe
Model:	JXA-8600
Analysis type:	EDS semiquantitative
Current:	1 nA
Calibrated	March 2011
Accelerating voltage:	15.0
Analysed:	19.2.2014 10:54



Au coated Calcite



Quantitative Results

Elt	XRay	W%	A%	Formula	Ox%	Cat#
C	Ka	7.80	47.18		0.00	0.00
O	Ka	2.34	10.64		0.00	0.00
Mg	Ka	0.24	0.72		0.00	0.00
Ca	Ka	5.81	10.53		0.00	0.00
Au	La	83.81	30.92		0.00	0.00
		100.00	100.00		0.00	0.00