

Supplement of Biogeosciences, 16, 2115–2130, 2019  
<https://doi.org/10.5194/bg-16-2115-2019-supplement>  
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*Supplement of*

## **Coupled calcium and inorganic carbon uptake suggested by magnesium and sulfur incorporation in foraminiferal calcite**

**Inge van Dijk et al.**

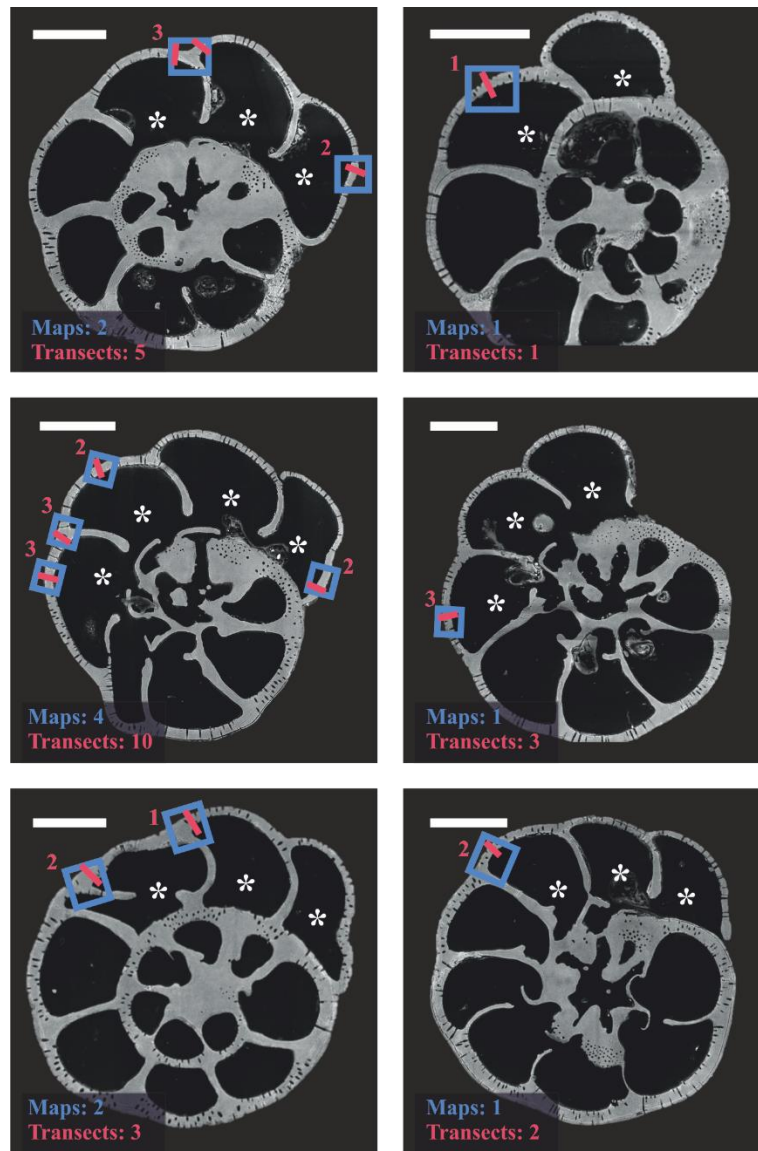
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## SUPPLEMENTARY INFORMATION

Species	EPMA maps total n	n specimens (n chambers)	Total n of transect maps (n of selected transect maps)
<i>A. tepida</i>	11	6(12)	24(12)
<i>B. marginata</i>	8	4(8)	16(8)
<i>A. lessonii</i>	8	6(9)	16(9)

**Table S1: Number of maps measured by EPMA per species, with number of specimens and chambers analyzed and total number of transect maps (S/Ca and Mg/Ca values reported in Fig. 6). Note that the number of chambers analyzed is higher than the number of maps, since some maps are selected on the cross sections of two chambers (see Fig. S1-3). The last column gives the number of transects maps selected for peak-base analysis, which was limited to one per chamber to avoid overrepresenting of one chamber. The values of the peak base analysis are reported in Fig. 7 and Table 2).**



**Fig. S1: Overview of specimens of *Ammonia tepida* analyzed by EPMA with map selection area (blue rectangle), number of transects per map (red) and transect use for peak-base analysis (red line). Total number of maps and transect per specimen is indicated in the bottomleft corner of every SEM overview picture. Chambers formed in culture are indicated with an asterisk. Scale bar = 100 $\mu$ m. NB, the map of top left specimen was used in Fig. 5.**

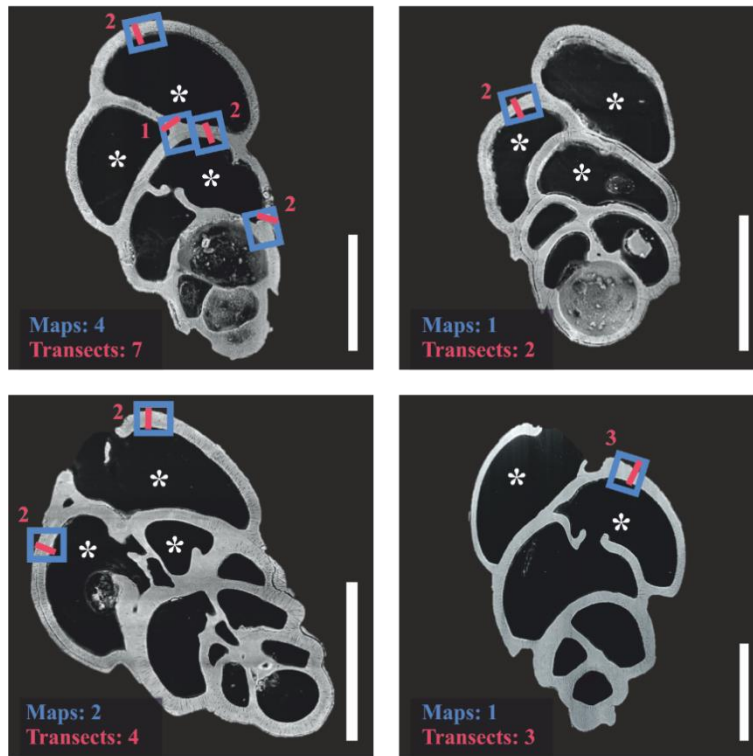


Fig. S2: Overview of specimens of *Bulimina marginata* analyzed by EPMA with map selection area (blue rectangle), number of transects per map (red) and transect use for peak-base analysis (red line). Total number of maps and transect per specimen is indicated in the bottomleft corner of every SEM overview picture. Chambers formed in culture are indicated with an asterisk. Scale bar = 100 $\mu$ m. NB, the map of bottom left specimen was used in Fig. 5.

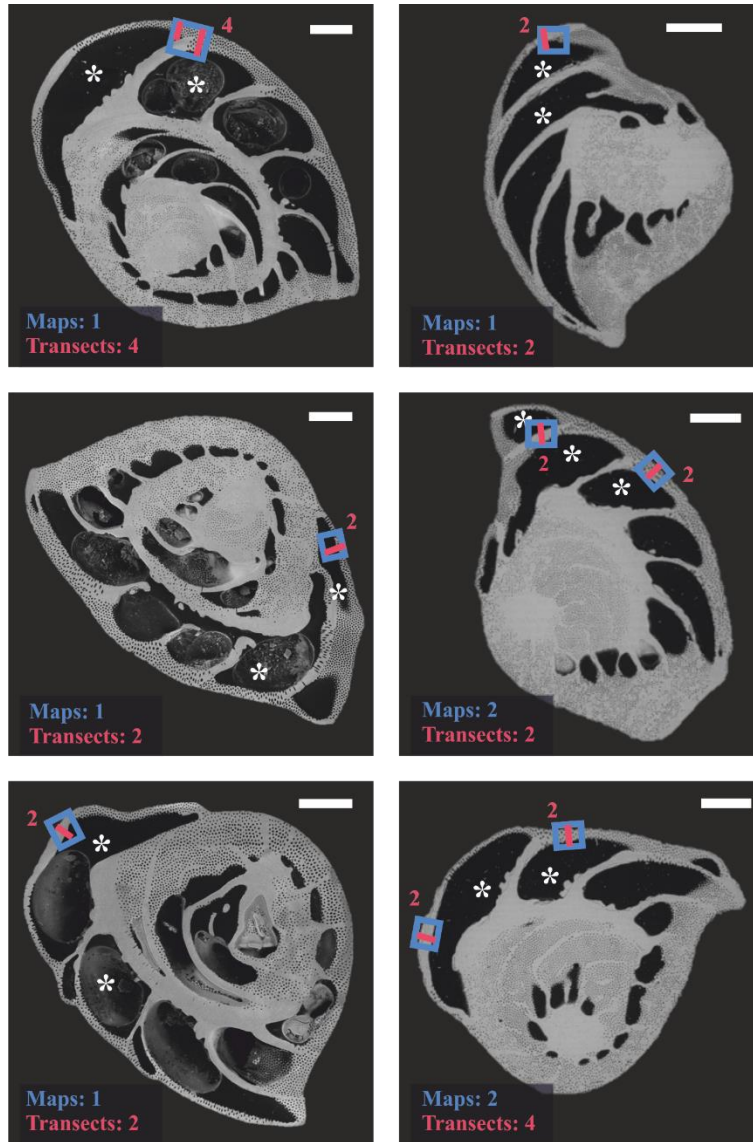
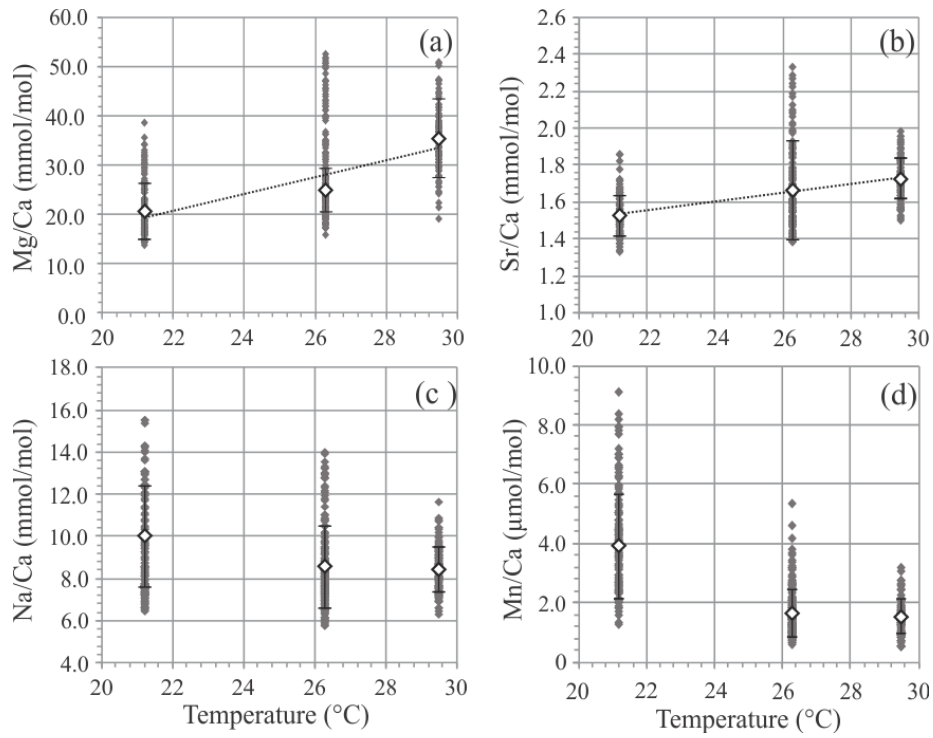


Fig. S3: Overview of specimens of *Amphistegina lessonii* analyzed by EPMA with map selection area (blue rectangle), number of transects per map (red) and transect use for peak-base analysis (red line). Total number of maps and transect per specimen is indicated in the bottomleft corner of every SEM overview picture. Chambers formed in culture are indicated with an asterisk. Scale bar = 100 $\mu$ m. NB, the map of top left specimen was used in Fig. 1 and 5.



**Fig. S4: Incorporation of magnesium (a), strontium (b), sodium (c) and manganese (d) of species *A. lessonii* expressed as E/Ca of individual laser ablation analysis (grey diamonds) and average values (white diamonds) of specimens cultured at 21.2, 26.3 and 29.5 °C. Mg/Ca increases linearly regression over averages by  $1.69 \cdot T - 16.50$  with  $R^2=0.87$ . Sr/Ca increases significantly ( $p < 0.05$ ) with temperature by  $0.024 \cdot T + 1.025$  ( $R^2=0.99$ ) based on the averages. Both Mn/Ca and Na/Ca values decrease when temperature increases from 21.2 to 26.3 °C, but no significant difference can be found between datasets of 26.3 and 29.5 °C ( $p = 0.37$  and  $0.051$  for Mn/Ca and Na/Ca respectively). For Sr/Ca all three temperature groups are significantly different ( $p < 0.05$ ), and the relation of the averages is  $Sr/Ca = 0.024 \cdot T + 1.025$  ( $R^2=0.99$ ).**

Temperature (°C)	Mg/Ca (mmol/mol)	Na/Ca (mmol/mol)	Mn/Ca ( $\mu$ mol/mol)	Sr/Ca (mmol/mol)
21.2 $\pm$ 0.7	20.5 $\pm$ 5.7	10.0 $\pm$ 2.4	3.9 $\pm$ 1.8	1.5 $\pm$ 0.1
26.3 $\pm$ 0.3	24.9 $\pm$ 4.4	8.6 $\pm$ 1.9	1.7 $\pm$ 0.8	1.7 $\pm$ 0.3
29.5 $\pm$ 0.2	35.4 $\pm$ 8.1	8.4 $\pm$ 1.1	1.6 $\pm$ 0.6	1.7 $\pm$ 0.1

**Table S2: Average element/Ca of *A. lessonii* from the controlled culture experiment by LA-ICP-MS.**

Species	<sup>24</sup> Mg/Ca mmol/mol (min-max)	<sup>32</sup> S/Ca mmol/mol (min-max)
<i>A. lessonii</i> (T. exp.)	27.43 (21.0-36.1)	1.48 (1.21-1.73)
<i>A. lessonii</i> (Aquarium)	36.81	2.15
<i>H. depressa</i> (Aquarium)	153.31	8.41
<i>S. orbiculus</i> (Aquarium)	173.20	10.03
<i>S. angulata</i> (Aquarium)	146.16	8.04
<i>S. communis</i> (Aquarium)	134.21	9.83
<i>Q. pseudoreticulata</i> (Aquarium)	150.27	8.40
<i>Quinqueloculina</i> sp. (Aquarium)	140.50	10.79

**Table S3: S/Ca and Mg/Ca values for larger benthic foraminifera from Burgers' Zoo (Aquarium) and *A. lessonii* from the temperature experiment (T. exp;) including min and max values.**



Species	Comment	<sup>24</sup> Mg/Ca mmol/mol (min-max)	<sup>32</sup> S/Ca mmol/mol (min-max)	
Hyaline	<i>A. lessonii</i>	Temperature experiment	27.43 (21.0-36.1)	1.48 (1.21-1.73)
	<i>A. lessonii</i>	Burgers' Zoo specimens (T=25°C)	36.81	2.15
	<i>H. depressa</i>	Burgers' Zoo specimens (T=25°C)	153.31	8.41
	<i>A. tepida</i>	EPMA (semi-quantitative)	3.93	1.74
	<i>B. marginata</i>	EPMA (semi-quantitative)	5.52	1.78
	<i>A. lessonii</i>	EPMA (semi-quantitative)	23.87	2.37
	Planktonic species	Field study (Mezger et al., in prep.)	4.14 (3.4-5.4)	1.35 (0.92-1.81)
	NFHS	Carbonate standard (Mezger et al., 2016)	2.95	0.83
	<i>A. lessonii</i>	Salinity experiment (van Dijk et al., 2017)	33.06 (33.0-34.1)	1.32 (0.44-0.47)
	<i>A. gibbosa</i>	pCO <sub>2</sub> experiment (van Dijk et al., 2017)	33.47 (33.0-34.3)	1.03 (0.95-1.3)
Porcelaneous	<i>S. orbiculus</i>	Burgers' Zoo specimens (T=25°C)	173.20	10.03
	<i>S. angulata</i>	Burgers' Zoo specimens (T=25°C)	146.16	8.04
	<i>S. communis</i>	Burgers' Zoo specimens (T=25°C)	134.21	9.83
	<i>Q. pseudoreticulata</i>	Burgers' Zoo specimens (T=25°C)	150.27	8.40
	<i>Quinqueloculina sp.</i>	Burgers' Zoo specimens (T=25°C)	140.50	10.79
	<i>S. marginalis</i>	pCO <sub>2</sub> experiment (van Dijk et al., 2017)	157.69 (155.8-159.6)	9.65 (8.95-10.40)

**Table S4: Overview of current available S/Ca and Mg/Ca data from several studies, including this study (in bold) and planktonic foraminifera standard NFHS (NIOZ foraminifera house standard). Min and maximum ranges are given when values varied for different culture conditions.**

## References

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