*Paleoceanography*

Supporting Information for

# Oxygen history off Baja California over the last 80 kyr: A new foraminiferal-based record.

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## Additional Supporting Information (Files uploaded separately)

Captions for Tables S1 (Named 2016PA003034RR-st01)

Captions for Datasets S1 (Named 2016PA003034RR-ds01)

## Introduction

This supporting information file contains 1 text, and 4 figures, together with their captions. A table and a large dataset containing census data is uploaded separately (captions in this file). As the present word file might lower the original quality of the appendices, they were uploaded separately as well.

**Text S1.**

Appendix 7: Explanation for the oxygen gradient assignation to the «*seminuda*», «*peregrina*» and «others» assemblages.

*Sen Gupta and Machain-Castillo* [1993] summarised the preferences of dissolved $O_2$ content for several common species off the Californian coast (Baja California, Santa Barbara Basin, Gulf of California, California Borderland and Point Sur). As pointed out by these authors, several *Bolivina* species are well adapted to oxygen deficient conditions, including *B. seminuda* (~ 0.1 $ml.L^{-1}$; average value between localities reported in the paper) and *B. subadvena* (~ 0.1 $ml.L^{-1}$). *Buliminella tenuata* (~ 0.3 $ml.L^{-1}$; ~ 0.1 $ml.L^{-1}$ in SBB) and *T. delicata* (~ 0.3 $ml.L^{-1}$) are also adapted to dysoxic conditions (in the sense of *Kaiho* [1994] classification: 0.1 – 0.3 $ml.L^{-1}$). It can thus be assumed that these four species, which dominate the «*seminuda*» assemblage, are indicators of dysoxic conditions. Alternatively, *B. spissa* and *E. smithi* are found in more oxygenated conditions (~ 0.5 $ml.L^{-1}$) meaning that the «*peregrina*» assemblage is likely to occur in intervals with slightly more oxygenation. This assemblage corresponds to suboxic conditions (0.3 – 1.5 $ml.L^{-1}$ according to *Kaiho* [1994] classification). *Cannariato and Kennett* [1999; and references herein] considered *B. argentea* and *B. tenuata* as part of a hypoxic assemblage (0.1 – 0.3 $ml.L^{-1}$), *B. spissa* and U. *peregrina* as part of a suboxic assemblage (0.3 – 1.5 $ml.L^{-1}$) and *E. smithi* as part of an oxic assemblage (> 1.5 $ml.L^{-1}$). *Moffitt* et al. [2014, 2015a] considered *B. argentea*, *B. spissa* and *U. peregrina* as part of an intermediate hypoxic assemblage (~ 0.5 – 1.4 $ml.L^{-1}$) also corresponding to the suboxic assemblage. These congruent assignations reflect the potential for some species to be used as robust paleo-oxygenation tracers. Principal species assigned to the "others" assemblage (*Hoeglundina elegans, Oridorsalis umbonatus, Planulina ecuadorana,* ? *Ceratobulimina* cf. *jonesiana, Uvigerina*

*mediterranea*) correspond to epifaunal and / or shallow infaunal (top first cm) species usually thriving in oxic conditions [*Rathburn* et al., 1996; *Schmiedl* et al., 1997; *Fontanier* et al., 2002; *Eberwein*, 2006; *Licari,* 2006; *Murray*, 2006]. Other species assigned to this oxic assemblage (e.g. *Cassidulina* spp., *Gyroidina* spp., *Trifarina* spp., *Fissurina* spp., *Lagena* spp., *Pullenia* spp., *Valvulineria* spp.) were all reported by Kaiho [1999] as «suboxic indicators B» dominating samples when $[O_2] > \sim 1$ ml.L$^{-1}$. The assemblage «others», composed of all the other species, is likely to occur in periods of even more oxygenation (Figs 3 and 6; H events) and is assigned to oxic conditions (> 1.4 ml.L$^{-1}$). This assemblage is usually associated with a high diversity (Fig. 6).

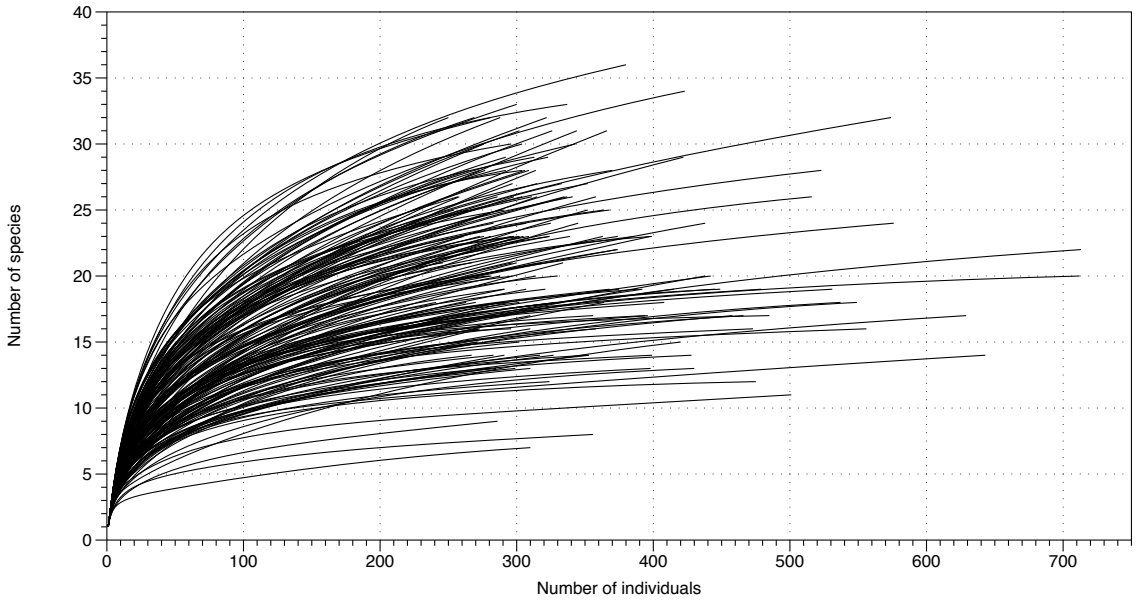


**Figure S1.**

Appendix 1: Individual rarefaction showing the number of taxa according to the number of specimens picked for every sample (line).


**Figure S2.**

Appendix 2: SEM images of the principal benthic Foraminifera composing the dysoxic and suboxic assemblages. **a-b** *Bolivina seminuda* Cushman, 1911. **c-d** *Bolivina subadvena* Cushman, 1926. **e-f** *Buliminella tenuata* Cushman, 1927. **g-h** *Takayanagia delicata* (Cushman, 1927). **i** *Uvigerina peregrina* Cushman, 1923. **j-k** *Bolivina spissa* Cushman, 1926. **l-m** *Bolivina argentea* Cushman, 1926. **n-o** *Epistominella smithi* (R.E. and K.C. Stewart, 1930). Scale bars 100 µm.

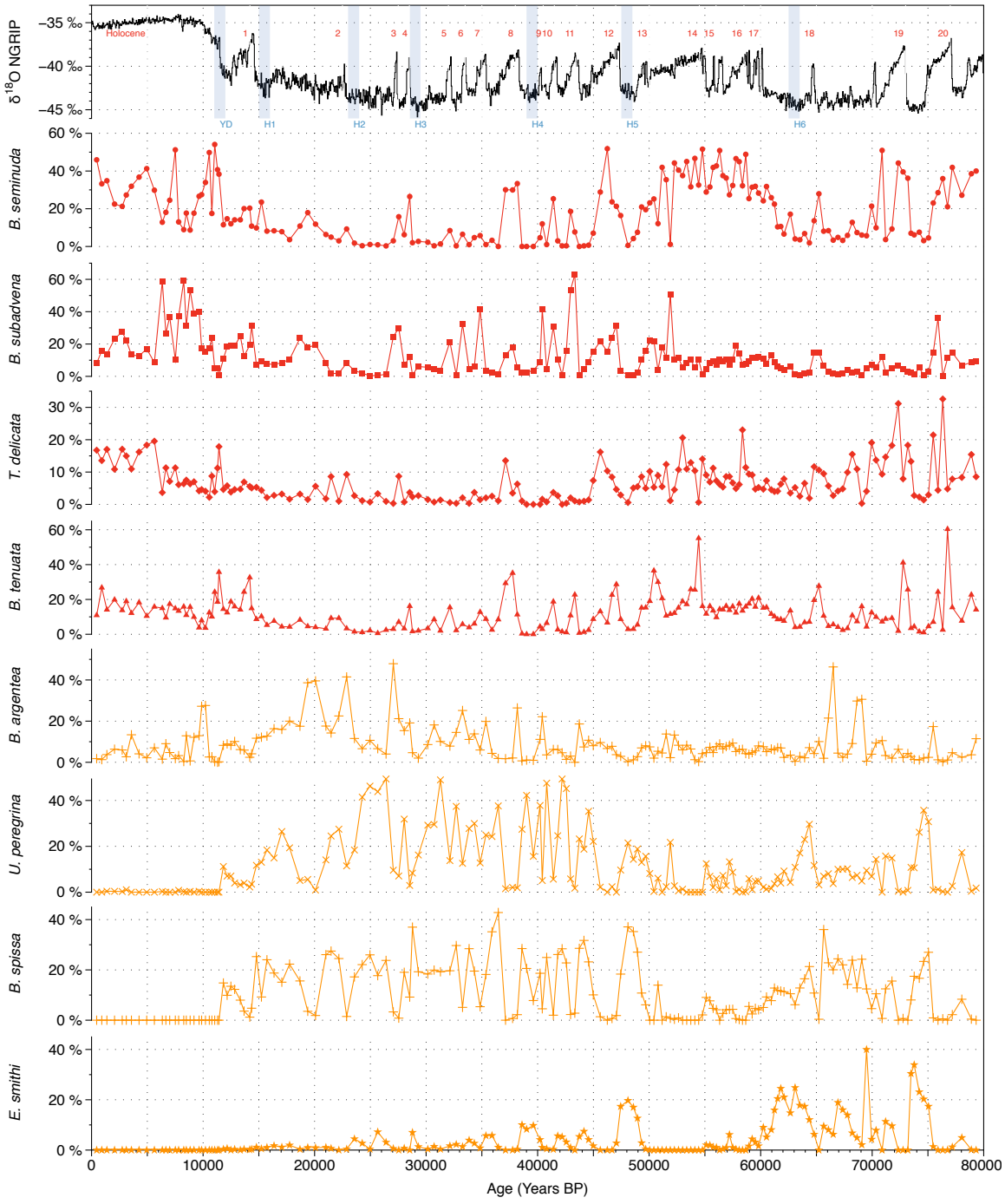
δ18O NGRIP
−35 ‰
−40 ‰
−45 ‰
Holocene
1
2
3 4
5 6 7
8
9 10
11
12
13
14 15
16 17
18
19
20
YD
H1
H2
H3
H4
H5
H6
B. seminuda
B. subadvena
T. delicata
B. tenuata
B. argentea
U. peregrina
B. spissa
E. smithi
60 %
40 %
30 %
20 %
10 %
0 %
0
10000
20000
30000
40000
50000
60000
70000
80000
Age (Years BP)

**Figure S3.**

Appendix 5: Isotopic composition of the NGRIP ice core ($\delta^{18}O$ ‰) recovered from Greenland and based on the SS09 sea time scale [*Johnsen* et al., 2001]. Relative abundance of the main species downcore composing the «*seminuda*» and «*peregrina*» assemblages.

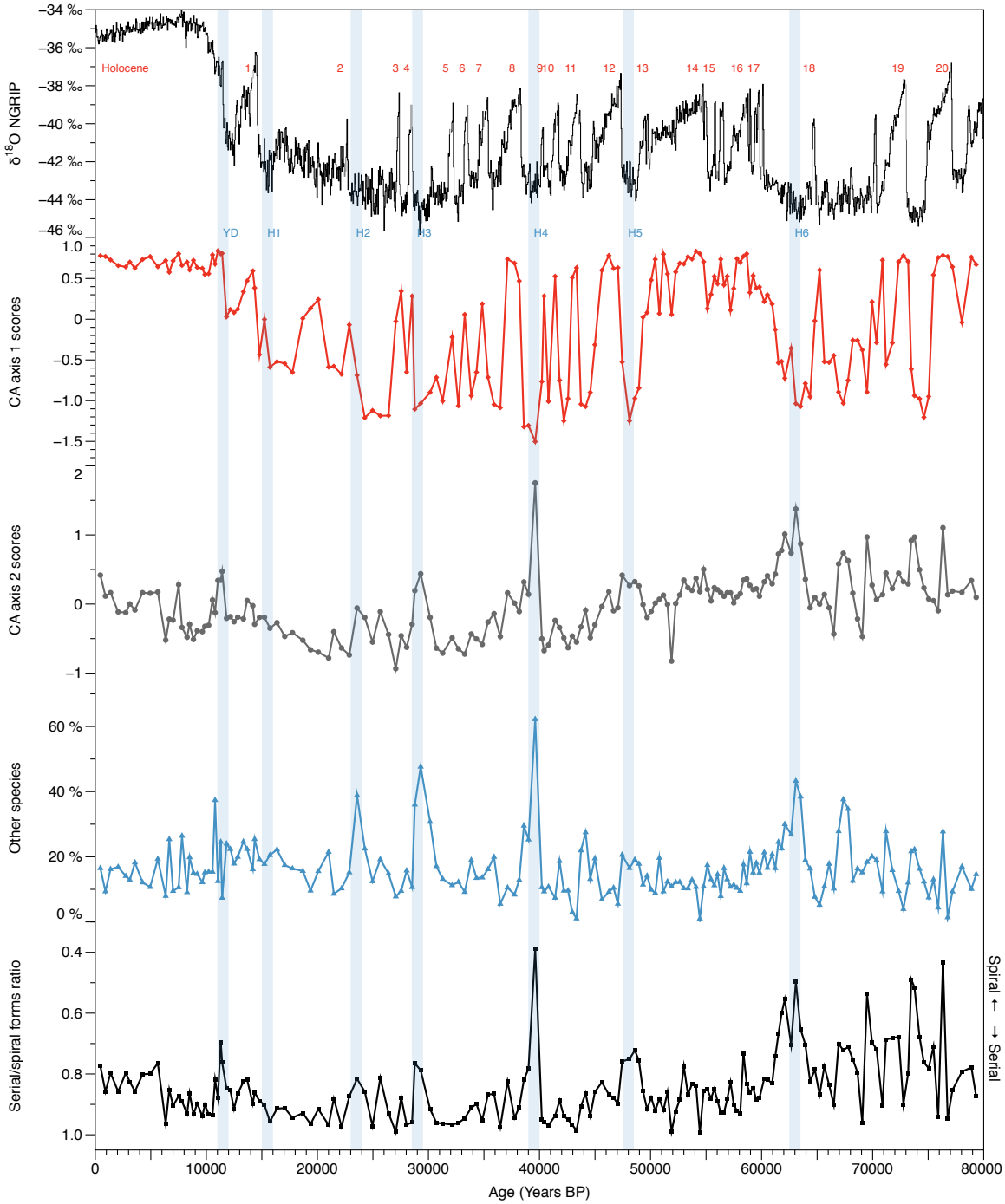


**Figure S4.**

Appendix 6: From top: Isotopic composition of the NGRIP ice core ($\delta^{18}O$ ‰) recovered from Greenland and based on the SS09 sea time scale [*Johnsen* et al., 2001]. Axis 1 scores from the Correspondence Analysis (CA) (25.96 % of the total variation). Axis 2 scores from the CA (10.16 % of the total variation). Relative abundance of the «others» assemblage. Serial/spiral tests

ratio: values close to 1 reflect dominance of serial forms, while values close to 0 reflect dominance of spiral forms.

**Table S1. (2016PA003034RR-st01)**

Appendix 4: First (PC1) and second (PC2) principal component loadings for each taxon that occurred within Core MD02-2508.

**Data Set S1. (2016PA003034RR-ds01)**

Appendix 3: Benthic foraminifera census counts for Core MD02-2508.