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Ocean Science Discussions

Interactive comment on "Electrochemical techniques and sensors for ocean research" *by* G. Denuault

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First I would like to thank the editors and referees for their careful reading of the article and helpful suggestions. The following modifications are being made to the final version of the article.

Issues pertaining to references:

- *"Grundig et al 1995 – capitalise NADH".* **Corrected**
- *"Kröger and Law 2005 (Umlaut in first authors name)".* **Corrected**
- *"Lacombe et al 2007 – "silicate determination"".* **Corrected**

- *"Luther et al 2001 appears not to be quoted in text".* **This reference was quoted on p. 1874 line 19**
- *"Montenegro et al 1991, repeated quoted in text but missing in bibliography."* **Corrected**
- *"Thomas et al. both references capitalisation of CTD".* **Corrected**
- *"Van Den Berg et al 1991 – comas missing between listed analytes."* **Corrected**
- *"Whitfield and Jagner 1981 – correct quote with full book details."* **Corrected**
- *"The author generally does a good job of referencing previous reviews and papers that adequately describe the specific techniques. An omission I noticed was that the author did not reference recent hydrothermal vent work using electrochemical techniques especially at high temperatures. These are significant technological advancements and include the pH, H2 and H2S measurements of Ding and Seyfried as well as the conductivity sensor of Larson et al which is a proxy for chloride as sulfate is in low concentration in hot vent waters. Le Bris et al have also developed a pH probe for diffuse flow vent lower temperature work. All these were briefly reviewed in Moore et al. Ding K, Seyfried WE. 2007. In situ measurement of pH and dissolved H2 in mid-ocean ridge hydrothermal fluids at elevated temperatures and pressures. Chemical Reviews 107: 601-22. Ding K, Seyfried WE, Tivey MK, Bradley AM. 2001. In situ measurement of dissolved H2 and H2S in high-temperature hydrothermal vent fluids at the Main Endeavour Field, Juan de Fuca Ridge. Earth and Planetary Science Letters 186: 417-25. Larson BI, Olson EJ, Lilley MD. 2007. In situ measurement of dissolved chloride in high temperature hydrothermal fluids. Geochimica Cosmochimica Acta 71: 2510-23. Le Bris N, Sarradin PM, Pennec S. 2001. A new deep-sea probe for in situ pH measurement in the environment of hydrothermal vent biological communities. Deep-Sea Res. Part I-Oceanogr. Res. Pap. 48:1941–51. Moore, T.*

S., K. M. Mullaugh, R. R. Holyoke, A. S. Madison, M. Yücel and G. W. Luther, III. 2009. Marine Chemical Technology and Sensors for marine waters: Potentials and Limits. Annual Reviews in Marine Science 1, 91-115." **The references have been added.**

Issues pertaining to figures:

- *"Figures Fig. 1: It would be useful if the peaks in the voltammogram would be labelled and explained as done in Fig.2."* **Labels have been added as suggested.**
- *"Fig 3. is not referred to in the text."* **Fig. 3 was referred to on page 1868, line 12.**
- *"Because the author also writes for non-electrochemists, I thought that another ?gure or two could be included that would expand on Table 2 and show the relationships between the various techniques better. For example, the author could show the various excitation signals over time along with the measurement parameter (I, E, Q, Z) and the relationship of the measuring signal to concentration or activity. I also thought that equations could be used to show how I, E, Q, Z relate to concentration or activity and that the relationship between concentration and activity could be explicitly stated. These additions would help in the stated objectives on page 1859 that these sensors ". . .are limited more by the lack of expertise. . ." that most researchers have in electro-chemical methods."* and *"Generally for illustration purposes it would be useful to include more figures showing typical outputs from other electrochemical techniques, such as amperometry or impedance spectroscopy (ideally one example for each technique explained)."* **Table 2 will be expanded and examples of outputs of some techniques added.**

Issues pertaining to pH sensors

- *Given the high priority measurements of parameters involved in climate change monitoring, such as pH have, it could be useful to further expand on the state of development of such sensors and maybe to explain what the current difficulties with standard pH electrodes are for oceanographic applications (reference electrode drift, need to differentiate very small changes, interferences, susceptibility to pressure changes for proofing instruments etc).* **Comments will be added.**

Interactive comment on Ocean Sci. Discuss., 6, 1857, 2009.