

International School "Understanding Oxygen Fugacity in Geoscience"

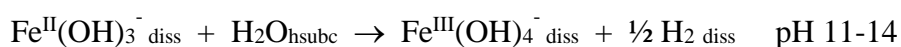
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**Participant's presentations**

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Presentation format (select one):	<i>Oral on-site</i>
Title:	<i>Ferric minerals at extremely low oxygen fugacity</i>
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The presentation shows that, at extremely low oxygen fugacity, in the absence of microorganisms and oxygen, ferrous ions and minerals can be oxidized when they interact with strongly alkaline high subcritical water. This conclusion arises from the analysis of graphics that show the redox potential  $E$  of the electrochemical system Fe-high subcritical water as a function of pH. The graphics were drawn in 2012 by W. Cook and R. Olive for metallurgic purposes and I analyzed the high pH sections.

In electricity, positive charges move from high electric potential to low electric potential, and negatives charges, such as electrons, move from low electric potential to high electric potential. An electrochemical system that undergoes chemical reactions evolves spontaneously in the direction of decreasing potentials. By analogy with electricity, I propose that electrons of an electrochemical system move towards higher potentials. Since 2013, applying this spontaneous change to the redox lines  $E^{\circ}_{\text{H}^+/\text{H}_2} = f(\text{pH})$  and  $E^{\circ}_{\text{Fe}^{3+}/\text{Fe}^{2+}} = f(\text{pH})$ , I show that the redox couple  $\text{H}^+/\text{H}_2$  oxidizes the redox couple  $\text{Fe}^{3+}/\text{Fe}^{2+}$  in the absence of oxygen, at pH 11-14, 300-350°C, 10-25 MPa, and water densities 700-600 kg/m<sup>3</sup>. The electron released from ferrous iron moves toward higher potential and the following equation can be written:



This redox equation can be applied to anoxic geological terrains in the Universe, such as Archean Earth (Bassez 2018) for which the surface O<sub>2</sub> levels are proposed, by Catling and Zahnle in 2020, to be <10<sup>-6</sup> PAL, present atmospheric level. The icy satellite of Saturn, Enceladus show data which can likewise be explained with this equation (Bassez 2019).

Bassez MP 2018 *Origins of Life and Evolution of Biospheres* 48, 289–320

Bassez MP 2019 Follow the high subcritical water. *Geosciences* 9, 249, 25p.

Catling, Zahnle *Sci Adv* 2020 6 eaax1420