

XPS analysis of corrosion products formed on mild steel surface

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Methods of investigation

Effect of an antibacterial drug, sulfacetamide (SA), on the composition of corrosion products formed on mild steel surface in 1.0 M HCl solution has been investigated using potentiodynamic polarization, electrochemical impedance spectroscopy and XPS analysis. Fig.1 shows XPS spectra.

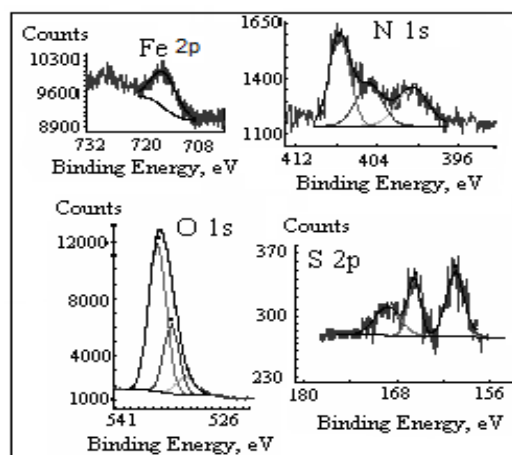


Figure 1: XPS spectra of mild steel surface corroded in 1.0 M HCl solution containing 4 mM sulfacetamide

Discussion of Results

In presence of SA, the surface layer consists of FeO (OH) rather than pure oxide [1, 2], adsorbed molecules of SA [2] and inorganic compounds (sulfides, carbonates, sulphates, nitrates) which were obtained by electrochemical decomposition of sulfacetamide [2]. More or less hypothetical compound such as schwertmannite, an iron-oxyhydroxysulfate mineral with an ideal chemical formula of $\text{Fe}_8\text{O}_8(\text{OH})_6(\text{SO}_4)_n\text{H}_2\text{O}$ or $\text{Fe}^{3+}_{16}\text{O}_{16}(\text{OH}, \text{SO}_4)_{12-13} \cdot 10-12 \text{H}_2\text{O}$ may be formed. It can be considered that the SA acts as an incipient 'rust transformer' and favors the formation of a 'superficial closed layer'.

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[1] Grosvenor *et al.* (2004) *Surf. Interf. Anal.* **36**, 1564–1574.

[2] Samide *et al.* (2011) *Digest J. Nanomat.Biost.* **6**, 663–673.

Stable isotope constraints on fluid flow in the Cascadia accretionary prism: Evidence for large flow transients during recent deformation

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The Cascadia subduction zone is a site of significant earthquakes with a recurrence interval of 240 to 530 years [1]. ODP drilling near the deformation front and on Hydrate Ridge has revealed pervasive deformation, and the formation of abundant gas hydrate, and in addition carbonate cements and veins [2]. The carbonates are proxies for fluid characteristics during the most recent active deformation and perhaps extending back to 2 Ma bp. Conventional and ion microprobe isotopic studies have shown that several fault horizons preserve carbonates with $\delta^{18}\text{O}_{\text{VPDB}}$ values as low as -22% , substantially out of equilibrium with modern pore water isotopic compositions and temperature. The values can be explained by transient flow events bringing in fluids from several kilometers remote from the drill sites, with substantially different isotopic compositions and temperatures. At one of the drill sites, $\delta^{18}\text{O}$ values are consistent with precipitation temperatures of $>100^\circ\text{C}$ at a depth of only 67 meters below seafloor (mbsf). Conventional and ion microprobe analyses cannot distinguish between fluid isotopic and temperature causation of the carbonate isotopic anomalies. We are planning to measure samples using the technique of clumped isotope analysis, which relies on the correlation between the prevalence of ^{13}C - ^{18}O - ^{16}O isotopologues ($\Delta 47$ measurements) in carbonate with temperature during carbonate formation, to determine temperature and oxygen isotopic composition of fluids. The new data presented here will bear on our model of periodic, nonsteady-state fluid migration in the Cascadia accretionary prism. These transient flow events likely occur at time scales of less than a year, and may be related to periodic large-magnitude earthquakes. Widespread pulses of warm fluids could potentially destabilize clathrates at Hydrate Ridge and result in release of large quantities of methane into the overlying water column and atmosphere.

[1] Goldfinger *et al.* (in press) *USGS Prof. Paper* **1661-F**.

[2] Sample (2010) *EPSL* **293**, 300–312.