Properties and structural role of iron in silicate melts and glasses

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Iron is an important element to probe the properties and the structure of silicate melts. In earth science most of lava contain more than 10% of iron whereas the proportion is much smaller in industrial materials. Iron usually occurs in two different valence states (Fe^{2+} or Fe^{3+}), and three coordination: 4, 5 and 6 for these different redox states. Thus, the influence of iron oxide on the melt properties is complicated. Consequently, the redox ratio of silicate glasses and melts is an important parameter which role must be properly studied to understand the physical and chemical properties of these materials.

The coordination of iron may evolve as a function of the redox state. These changes are due to the fact that iron is essentially present in the form of Fe^{3+} in tetrahedral position at lower temperatures whereas it mainly occurs as Fe^{2+} in 6-fold coordination at higher temperatures. These changes in the iron coordination may influence the short range order around network modifier, such as Na or Ca. Our goal is to understand the importance of those coordination modifications caused by the change in iron redox.

X-ray absorption spectroscopy experiments are very valuable to determine short-range order. It should allow us to study the iron valence and coordination, as well as the sodium and calcium environment. However this technique is not always accessible. Therefore, other experimental methods must be used to study the network modifications such as Raman spectroscopy and electron microprobe.

We focused our work on the changes which happen in the glass during the transition between different redox states. Especially with regard to the network structure and the local environment of network-modifier elements.

Temporal variations in the composition and age of terrestrial organic carbon transported by the Yellow River

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The Yellow River is the World's highest turbidity major fluvial system, delivering over 1×10^9 t of sediments annually into the Chinese marginal seas, accounting for ~7% global sediment flux to the ocean. Organic carbon carried by the Yellow River therefore may play a significant role in the global and regional organic carbon cycle.

The focus of the present study is to develop an understanding of the sources, composition and age of terrestrial organic carbon that is carried by the Yellow River and supplied to the adjacent Bohai Sea and Yellow Sea. Near-surface suspended particulate matter samples were collected nearby the Lijing Station, ~50 km upstream of the river mouth (Dongying), as part of a sampling campaign between June 2011 and June 2012 in order to assess seasonal variations in fluvial supply. In addition to bulk properties, the abundance and carbon isotopic composition of source-specific biomarkers (fatty acid & alkanes) were measured.

The concentrations of higher plant-derived long-chain ($\geq C_{24}$) *n*-alkanes, *n*-fatty acids and particulate organic carbon (POC) co-varied with total suspended solid (TSS) concentrations, with peak abundances during summer and early autumn, indicating plant-derived organic carbon is controlled by the overall flux of terrestrial sediments, which in turn is influenced by flood events and human activities.

POC in the Yellow River exhibits relatively uniform $\delta^{13}C$ values (-23.94 to -24.37‰), and old radiocarbon ages (4000 to 4600 ^{14}C years). Radiocarbon ages of short-chain (C_{16}, C_{18}) fatty acids were variable but generally modern (from 560 years to greater than modern), suggesting they are sourced from fresh terrestrial debris, but more likely from aquatic productivity during warm and low-turbidity periods. In contrast, long-chain fatty acids display a relatively narrow and pre-aged range from 1550 to 2080 years.

These results, and associated molecular and isotopic information, indicate that the aged OC – likely sourced from soils on the Chinses loess plateau within the drainage basin – contributes significantly to the suspended load of the Yellow River.

Acknowledgements: This study is supported by the China Scholarship Council and the NSFC (grant No. 41020164005).

DOI:10.1180/minmag.2013.077.5.20