Complementary methods for characterization of stream sediments as an aid in assessment of sediment quality

H. BILINSKI[1], S. FRANČIŠKOVIĆ-BILINSKI[1], M. NEČEMER[2], D. HANŽEL[2], G. SZALONTAI[3] AND K. KOVÁCS[3]

[1]Institute "Ruđer Bošković", POB 180, HR-10002 Zagreb, Croatia (bilinski@irb.hr, francis@irb.hr)
[2]Institute "Jožef Stefan", Jamova 39, SI-1001 Ljubljana, Slovenia (marijan.necemer@ijs.si, darko.hanzel@ijs.si)
[3]University of Veszprém, Pf. 158, H-8200 Veszprém, Hungary (Gabor.Szalontai@sparc4.mars.vein.hu, kris@almos.vein.hu)

Introduction

The European water framework directive (WFD) has not come yet up with environmental quality standards for sediments. It is still open which sediment monitoring approaches will be used.

The aim of the present work is to demonstrate on selected stream sediments what type of characterization can be obtained when using interdisciplinary approach.

Methods

Complementary methods were: X-ray diffraction (XRD), inductive coupled plasma – mass spectroscopy (ICP-MS), X-ray fluorescence (XRF), solid state ^{27}Al MAS NMR, ^{29}Si MAS NMR, grain size analysis and Mössbauer spectroscopy.

Results, discussion and conclusion

Advantages and disadvantages of each method were discussed. Solely ICP-MS method requires chemical decomposition. It is the most useful for microelement analysis (51 element), which data can be used in geostatistical analysis and detection of anomalies. Other techniques are non destructive and require simple physical sample preparation. XRD method can give with certainty class and group of minerals. Determination of clay minerals, when present <5%, is less certain. XRF method is suitable for determination of major elements, particularly of Si and limited number of trace elements. However, Mg and Na cannot be detected. The particle size distribution was determined in fraction <63 µm. It was found that the amount of clays (fraction <4 µm) was in the range 7.4 – 12.6%. Mössbauer spectra taken at room temperature and at 70 K in a mixture of several minerals are difficult to interpret. Valuable information concerning the valence and site populations of iron in poorly crystallized minerals can be obtained. Solid state ^{29}Si MAS NMR can give structural information, like the number of different SiO_4, $Si(Al)O_3$ units. ^{27}Al MAS NMR gives the presence and number of tetrahedral and octahedral Al sites and their ratio. Grain size analysis and surface area of particles is a fundamental property of sediments and is important in pollution research. All of the studied methods are recommended in future sediment analysis.

Oxygen isotope heterogeneity and disequilibria of olivine phenocrysts in large volume basalts: Case of Iceland

ILYA BINDEMAN[1*], ANDREY GURENKO[2], OLGEIR SIGMARSSON[3] AND MARC CHAUSSIDON[4]

[1]Department of Geological Sciences, 1272 University of Oregon, Eugene, OR, USA (bindeman@uoregon.edu)
[2]Max-Planck-Institut für Chemie, Mainz, Germany
[3]CNRS, Clermont-Fd, France; EarthSciences,Univ.of Iceland
[4]CRPG-CNRS, Nancy, France

Olivine phenocrysts in the largest volume Holocene fissure basalts from Iceland's eastern rift zone are moderately to severely out of oxygen isotope equilibrium with their host magma. We present a set of laser fluorination analysis of >70 individual and bulk crystals of olivine and plagioclase, and their host glasses with average precision of better than 0.07‰. We also report ion microprobe analyses of cores and rims of 61 olivine crystals from 13 samples with precision on single spots of 0.10-0.35‰ (1stdev). Within each sample studied, we find that basaltic glass is relatively homogeneous, plagioclase phenocrysts exhibit δ^{18}O variability, while individual olivines are more variable and span from mantle values of 5.2‰ down three permil below, in equilibrium with their low-δ^{18}O glass. The famous Laki basalt studied here still holds the record heterogeneity [1]. In addition, we have found subtle to severe Δ^{18}O(melt-olivine) and Δ^{18}O(plagioclase-olivine) relationships. Many olivines exhibit small variations in Fo, Ni, Mn, Ca contents and grains that are zoned in both Fe-Mg and δ^{18}O exhibit positive correlation of these parameters. Equilibrium thin rim is present around all grains in a single sample regardless of the degree of δ^{18}O or Fe-Mg disequilibria. These cation inhomogeneity suggests rather short 100 s of years timescales of transformation of these normal δ^{18}O basalts into low-δ^{18}O magmas.

Basalts studied here exhibit positive correlation of δ^{18}O with the degree of U-series disequilibria suggesting that assimilated low-δ^{18}O crust is older than several ka.

The pervasive lack of oxygen isotopic equilibrium suggests that olivines found in Iceland basalts cannot be used as proxies for the mantle magma compositions. They instead reflect shallow crustal petrogenesis and cannibalization of low-δ^{18}O Pleistocene predecessor in each volcanic system. This is achieved by remelting of buried Pleistocene hyaloclastites, altered by synglacial meltwaters, as the source for Holocene volcanism.

References

[1] Bindeman *et al*., 2006, *EPSL*, **245**: 245-259.