ESRF	**Experiment title:** **Characterization of the evolution of crustal fluids from oceanic ridges to subduction zones**	**Experiment number**: CH-1053
Beamline: ID22	**Date of experiment**: from: 11-April-01 to: 13-April-01	**Date of report**: 20 August 01
Shifts: 6	**Local contact(s)**: Alexandre SIMIONOVICI	*Received at ESRF:*

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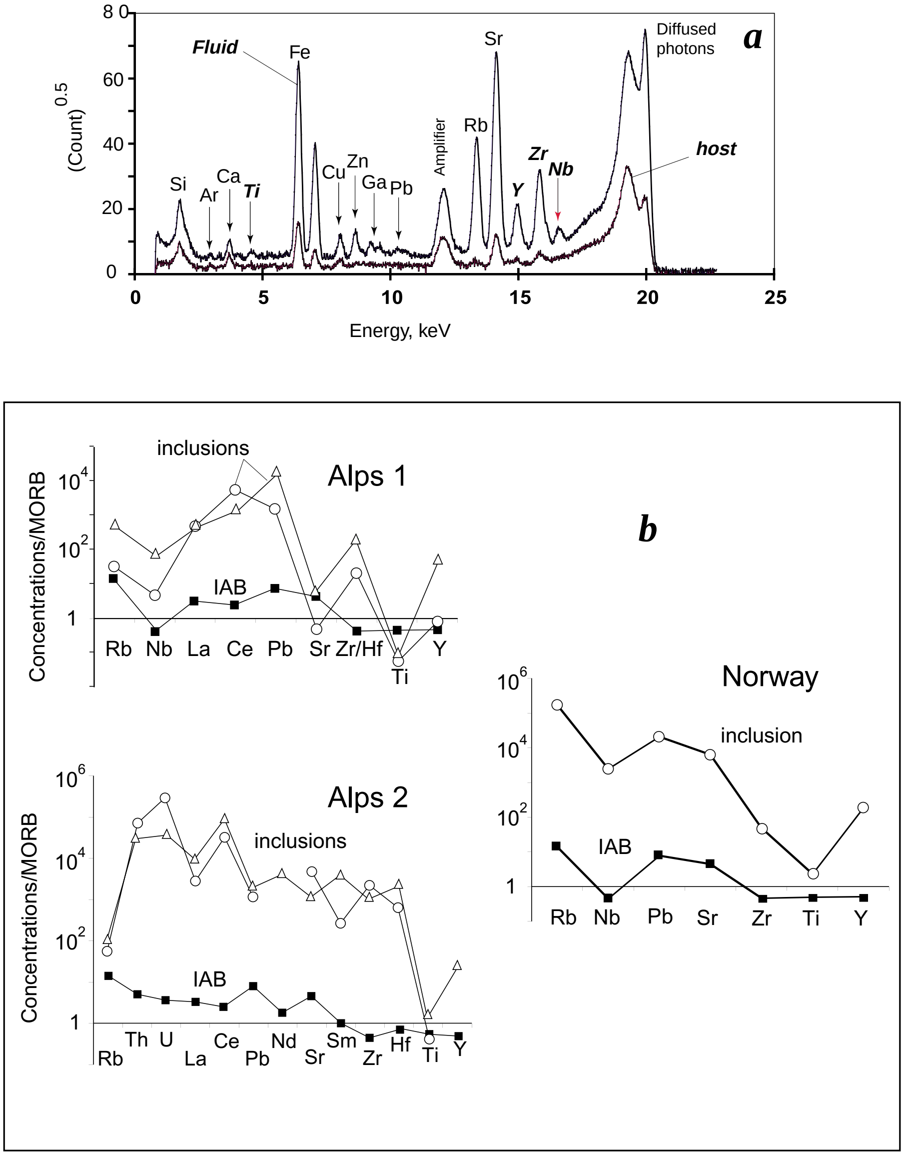
Report:

Inverse geochemical models have long predicted that the fluid phase released from the subducted slab to produce destructive island-arc magmas should be depleted in High-Field Strength Elements (HFSE, Zr, Ti, Hf, Nb, Ta) and enriched in Large Ion Lithophile Elements (Ba, Sr, Rb, Th, U…) compared to Mid-Ocean-Ridge Basalts (MORB). However, owing to the impossibility of direct sampling of the released fluid at the depth locus of island arc magma generation (80-100 km), this prediction has never been verified. The aim of experiment CH1053 was to test if fluid inclusions trapped in rocks that have buried to great depths (*eclogitic rocks* formed between 60 and 150 km depths) in subduction zone and that have been brought to the Earth's surface where they are currently exposed, could provide the first **direct information** on the composition of the component released from the subducted slab. This study has been the subject of the M. Sc degree of David Molinari (Molinari, 2001) under the supervision of P. Philippot.

The *eclogitic rocks* studied concern three main occurrences of the European Alps and the Norwegian Caledonides. The rocks analyzed have been the subject of intensive studies during the last decade by our group. Our preliminary goal was to evaluate to what extent HFSE were mobilized in eclogitic conditions. For this reason we used monochromatized beams of 12.9 and 20 keV incident energies, which are close to the absorption edge of Hf and Ta L lines (11.68 keV), and of Y, Zr and Nb K lines (18.98 keV), respectively. Five inclusions have been analysed in detail during the course of this experiment. About 10 analyses of 15 minutes acquisition each were performed for each fluid inclusion because, as shown by Ménez et al., (2001), mean concentration values are generally representative within 20% of reference concentrations, whereas the standard deviation can be large (up to 100 % of the mean).

Figure 1a shows a typical X-ray spectra obtained on a single fluid inclusion at 20 keV using a compound refractive lens. Also show is a control spectrum obtained on the host quartz several tens of µm away from the fluid inclusion. Important to note is the presence of marked peaks of Y, Zr and Nb in addition to more incompatible elements like Rb and Sr. X-ray analysis performed at 12.9 keV have generally revealed the presence of Hf but not Ta. Figure 1b plots the mean elemental concentrations for the different fluid inclusions studied, normalized to Mid-Ocean Ridge Basalt (MORB). Also shown are the normalized concentrations of Island Arc Basalt (IAB). The MORB can be considered as the mantle rock reference prior to contamination by a slab fluid, while the IAB represents the end product formed by melting of MORB-like rocks in response to contamination by a slab fluid. If our hypothesis is valid, the inclusion fluids analysed should display a trace element pattern similar to IAB.



Two main observations emerge from Figure 1b. First, with the exception of Ti in samples Alps1 and Alps2, all element concentrations of inclusion fluids are enriched compared to IAB. This is particularly true for incompatible elements like CE, Pb, U and Th which concentrations are up to 4 order of magnitude higher in eclogitic fluids than in IAB. Second, with the exception of Zr and Hf in sample Alps 2, all HFSE (Ti, Nb, Zr, Hf, Y, Hf) have concentrations lower than LILE, which is in good agreement with the IAB elemental pattern (see Alps1 and Norway).

These results represent the first direct evidence for the presence of a fluid phase containing a large variety of trace elements preserved in subducted rocks. These preliminary data are fundamental because the inclusion fluids display a trace element pattern comparable to that of IAB. This in turn is invaluable for developing forward petrogenetic models of island arc magma generation. The results obtained during the 6 shifts allocated are not sufficient, however, for publication. In order to prove that the elemental patterns shown in Figure 1b are reproducible and occur in all types of eclogitic rocks independently of their origin and bulk composition, it is crucial at this stage to obtain additional data on a variety of samples of different provenance (Dabieshan, China, Alps and Norwegian Caledonides among the most famous localities). Only such a systematic would allow elaborating a first order geodynamic model to be published in a first rank journal. For this reason, we have submitted a continuing proposal this semester.

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