

## **Titre du projet : Evolution of the deep Earth mantle: message from the hottest melts (komatiites). EDEM**

*Volet : **Recherché***

*Porteur du projet : SOBOLEV Alexander*

*Laboratoires impliqués : **ISTerre***

## **Bilan du projet pour l'année 2017**

### **Bilan d'activité** (1 page max)

1. We have developed and published new analytical protocol for ultra-precise measurements of major and trace elements in mineral olivine by ISTerre EPMA facility (Batanova et al, 2017, 2018). The analytical precision for minor and trace elements (Na, Al, P, Ca, Ti, Cr, Mn, Co, Ni, Zn) analysed in olivine at 25 kV accelerating voltage and 900 nA beam current is 4-18 ppm (2 standard deviations) and is similar to the detection limit of corresponding elements. An evaluation of the accuracy of trace element analyses in olivine has been made by comparing EPMA data for new reference samples with data obtained by different in-situ and bulk analytical methods in six different laboratories worldwide (Batanova et al, 2017). For all elements, the measured concentrations in the olivine reference sample were found to be identical (within internal precision) to reference values, suggesting that achieved precision and accuracy are similar. The spatial resolution of EPMA in a silicate matrix, even at very extreme conditions does not exceed 7- 8  $\mu\text{m}$  and thus is still better than laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) or secondary ion mass spectrometry (SIMS) of similar precision. These make the electron microprobe an indispensable method with applications in experimental petrology, geochemistry and cosmochemistry.
2. Major and trace elements, and volatile components have been measured in melt inclusions in olivine from fresh 2.7 Ga old komatiites from the Reliance Formation of the Belingwe Greenstone Belt, Zimbabwe (Asafov et al, 2017, 2018). The primary melt composition, estimated using melt inclusions and the composition of the most magnesian olivine (Fo 93.5), contains up to 27.5 wt% MgO and ca. 0.2 wt% H<sub>2</sub>O. The presence of H<sub>2</sub>O slightly depressed the liquidus temperature to ca. 1513 °C. Our results suggest formation of the Belingwe komatiite magma at ca. 7 GPa pressure and ca. 1790 °C temperature in a mantle plume. The plume picked up water and probably chlorine through interaction with a hydrous transition mantle zone in the way similar to that previously proposed by Sobolev et al. (Nature 2016) for komatiites in Canada.
3. We conducted a new set of 150 experiments (at 1 atm total pressure, 1300-1600°C,  $f_{\text{O}_2} = \text{NNO} \pm 2$ ) with highly precise Ni ol-melt partition coefficients to reexamine the compositional and temperature dependence of Ni partitioning between olivine and melt. In addition, we used new high precision Ni data on olivines from Archean komatiites, which are ideally suited to test the temperature dependence of Ni partitioning. We find that the major control on Ni partitioning in olivine is in fact compositional, whereas the temperature dependence is only about half as large as that suggested in literature. The results reinforce the requirement for olivine-free sources in many ocean island basalts and confirm dominantly peridotitic sources for most komatiites (Sobolev et al, 2017).

## Production scientifique (articles scientifiques, actes de congrès...)

### Papers in peer reviewed magazines

- Asafov E.V., Sobolev A.V., Gurenko A.A., Arndt N.T., Batanova V.G., Portnyagin M.V., Garbe-Schönberg D., Krasheninnikov S.P. (2018). Belingwe komatiites (2.7 Ga) originate from a plume with moderate water content, as inferred from inclusions in olivine. *Chemical Geology* **478**, 39-59.
- Batanova V.G., Sobolev A.V. and Magnin V., 2018. Trace element analysis by EPMA in geosciences: detection limit, accuracy and precision. *IOP Conf. Ser.: Mater. Sci. Eng.* **304** 012001.

### International Conference Talks and abstracts

- Asafov E.V., Sobolev A.V., Gurenko A.A., Arndt N.T., Batanova V.G., Portnyagin M.V., Garbe-Schönberg D., Krasheninnikov S.P., Wilson A.H. and Byerly G.R. (2017) Olivine-Hosted Melt Inclusions in the Ancient Komatiites – the Potential Key to the Archean Mantle Composition. "European Current Research On Fluid and melt Inclusions" ECROFI-2017 Nancy, France.
- Asafov E.V., Sobolev A.V., Gurenko A.A., Arndt N.T., Batanova V.G., Portnyagin M.V., Garbe-Schönberg D., Krasheninnikov S.P. (2017) Water in the 2,7 Belingwe komatiite magma inferred from the melt inclusions in olivine. Goldschmidt Conference 2017, Goldschmidt Conference 2017, Paris, France.
- Batanova V.G., Sobolev A.V. and Magnin V. (2017). Trace element analysis in EPMA: current state and perspectives. **Invited keynote plenary talk** at 15 th European workshop on Modern developments and applications in microbeam analysis, Konstanz Germany.
- Sobolev A.V. Inclusions of mantle derived melts: challenges and recent results. **Invited keynote plenary talk** at Conference "European Current Research On Fluid and melt Inclusions" ECROFI-2017 Nancy, France.
- Sobolev A.V., A.W. Hofmann, S.P. Krasheninnikov, V.G. Batanova, E.V. Asafov, N.T. Arndt, A.N. Koshlyakova and Borisov A.A. (2017) New experiments and komatiites vindicate nickel in magmatic olivine as a monitor of mantle lithology. Goldschmidt Conference 2017, Paris, France.

## Bilan financier succinct (avec suivant les cas : co-financements éventuels, équipements achetés, missions, recrutements divers, fonctionnements divers...)

The total amount of 10097 Euros has been spend on maintaining of EPMA facility of ISTERre.

 <b>LABORATOIRE :</b> ISTERR ISTERRE <b>SYNTHESE D'UNE ENTITE DEPENDSIERE</b> <b>GESLAB</b> <b>GESTION FINANCIERE</b>	<b>II - Historique des commandes et des factures du 01/01/2017 au 31/12/2017</b>		<b>Le :</b> 07/02/2018
			<b>Exercice :</b> 2017
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<b>Entité dépendsière :</b> LABSOB	<b>J/LabexREC/RAC409/Fds623/SOBOLEV</b>	<b>Crédites reçus :</b> 20 000,00	<b>Disponible :</b> 9 903,00
		<b>Cumul consommé :</b> 10 097,00	
		<b>Cumul réservé :</b> 0,00	
		<b>Cumul facturé :</b> 1 630,00	

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78878	BATANOV	12/07/17	FO	S	JEOL	4500092632 REP SPECTROMETRE V.BATANOVA	0,00	1 630,00	0,00	1 630,00	Origine LABEXOSUG2		
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78879	BATANOV	13/07/17	FO		JEOL	4500092669 MAINT. PREVENTIVE V.BATANOVA	0,00	8 150,00	0,00	0,00	Origine LABEXOSUG2	2017	30/08/17
80839	MAGNIN	20/11/17	FO		BUEHLER FRANCE	ACHAT DRAP ET SUSPENSION V.MAGNIN	0,00	317,00	0,00	0,00	Origine LABEXOSUG2		
<b>Totaux pour l'entité dépendsière LABSOB</b>							0,00	10 097,00	0,00	1 630,00	facturé sur l'exercice facturé antérieur		