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The analyses done under the direction of the professor M. Kusakabe take part in a PhD project whose aim is to understand the interactions between high temperature volcanic gases and volcanic lakes superficial waters. The two major sites studied are the Kaba and the Dempo volcanoes located in Sumatra (Indonesia). Both present at their summit one or several active crater lakes with extremely acidic and mineralized waters. An other feature of those lakes is their high contents in dissolved bisulfate but also the presence of elemental sulfur in their waters that could be explained by the disproportionation reaction of magmatic SO_2.

The work carried out consisted to learn and to apply the analytical techniques used for sulfur and oxygen isotopes determination. This in order to be able later to understand the processes that could influence the crater lakes chemistry.

Sulfur isotopic analysis were made on SO_2 gas coming from de thermal decomposition of $BaSO_4$ precipitates mixed with V_2O_5 and SiO_2, following the method described by Yanigasawa and Sakai (1983)[1]. As for the oxygen isotopic analysis they were made on CO_2 resulting from the decomposition of $BaSO_4$ previously mixed with graphite, following the procedure discribed by Rafter (1967)[2].

As a remark some tests were made on the $BaSO_4$ preparation:

(1) some samples of water containing natural dissolved bisulfate were passed though cation and anion exchange columns before $BaSO_4$ precipitation by addition of $BaCl_2$, other were not;
(2) most of the elemental sulfur samples were dissolved in hot aceton for sulfides separation (ex.pyrite, barite) before being oxidized with bromine and nitric acid to sulfuric acid and then converted to $BaSO_4$, but measurments were made also on samples with no aceton pretreatment.

All the isotopic values obtained for the different samples preparations felt within the accuracy of ± 0.2 ‰ for $\delta^{34}S$ measurments. An example can be given for the sample K8 that has a $\delta^{34}S_{HSO4}$ value of 18.969 ‰ without columns treatment and 18.913 ‰ with columns treatment.

All the data collected are listed in tables 1 and 2 (see following pages).

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[1] Yanagisawa, F. and Sakai, H., 1983. Thermal decomposition of barium sulfate-vanadium pentaoxide-silica glass mixtures for preparation of sulfur dioxide in sulfur isotope ratio measurements. *Anal. Chem.*, **55**: 985-987.

[2] Rafter, T.A., 1967. Oxygen isotopic composition of sulphates-Part 1. A method for the extraction of oxygen and its quantitative conversion to carbon dioxide for isotope ratio measurments. *N.Z.J.Sci.*, **10**: 493-510.

Table 1. Sulfur and oxygen isotopic analyses (in $^{0}/_{00}$) of dissolved sulfates.

Sample	Date	Comment	$\delta^{34}S_{HSO4}$	$\delta^{18}O_{HSO4}$
Kaba volcano (Indonesia):				
Lake				
K3	24/05/99	Kaba Lama	17,8	–
K13	26/05/99	Kaba Baru	9,9	–
K07	4/07/00	Kaba Lama	13,9	–
K015	5/07/00	Kaba Lama	13,1	–
Hot spring				
K8	25/05/99		19,0	15,8
K10	25/05/99		18,1	16,7
K16	4/06/99		19,1	16,6
K01	3/07/00		18,7	16,6
K02	3/07/00		18,5	16,8
K03	3/07/00		18,1	17,8
K04	3/07/00		17,8	17,5
K05	3/07/00		17,3	17,9
K06	3/07/00	idem K8	18,8	15,7
Sulfur pool				
K4	24/05/99	suspended el. sulfur	18,9	–
K5	24/05/99	yellow el. sulfur	10,5	–
K12	25/05/99	suspended el. sulfur	14,9	–
K18	4/06/99	suspended el. sulfur	20,9	–
K19	4/06/99	suspended el. sulfur	15,6	–
K08	4/07/00	yellow el. sulfur-idem K5	5,7	–
K09	4/07/00	grey el. sulfur	6,6	–
K010	4/07/00	yellow el. sulfur	14,5	–
K011	4/07/00	grey el. sulfur-idem K12	15,9	–
K012	4/07/00	"blue water"	18,2	–
K013	4/07/00	grey el. sulfur-idem K19	15,9	–
K014	4/07/00	grey el. sulfur-idem K18	20,4	–
Dempo volcano (Indonesia):				
Lake				
DL1	29/06/00	surface water	17,0	16,0
DL2	29/06/00	surface water	16,9	16,0

Sample	Date	Comment	$\delta^{34}S_{HSO4}$	$\delta^{18}O_{HSO4}$
Santa Ana volcano (Salvador):				
Ana 1	29/01/00	lake (-25m)	16,0	13,8
Ana 2	29/01/00	hot spring	14,5	–
Ana 3	29/01/00	hot spring	16,1	–
V1	?/07/00	lake	16,0	–
V2	29/01/00	hot spring	14,9	–
V3	?/08/00	lake	16,0	–
V4	?/01/00	lake	16,0	–
Kelut volcano (Indonesia):				
Kel 3	?/05/00	lake	12,5	–
Kel 4	14/07/00	lake	12,5	–
V6	?/?/96	lake	14,7	–
Aoba volcano - Voui Lake (Vanuatu):				
V8	?/06/00	lake	11,8	–

Table 2. Sulfur isotopic analyses (in $^{0}/_{00}$) of elemental sulfur and alteration minerals.

Kaba volcano (Indonesia):

Sample	Date	Comment	$\delta^{34}S_s$
5	24/5/99	inactive sulfur pool	-5,2
7	24/5/99	inactive sulfur pool	-4,8
9	24/5/99	inactive sulfur pool - spherule	-4,4
16	24/5/99	active sulfur pool - K5	-3,7
17	6/04/99	active sulfur pool - K18	-4,5
17*	6/04/99	active sulfur pool - K19	-3,3
18	6/04/99	Kaba lama lake shore	-4,3
19	6/04/99	Kaba lama lake shore	-3,9
19'	6/04/99	19 without sulfides separation	-4,0
20	6/04/99	sediment	-3,6
21	6/04/99	sediment	-4,2
22	6/04/99	sediment	-4,0
23	7/04/00	active sulfur pool - K011	-4,1
24	7/04/00	active sulfur pool - K013	-4,7
25	7/04/00	active sulfur pool - K014	-4,4

Dempo volcano (Indonesia):

Sample	Date	Comment	$\delta^{34}S_s$
1	?/09/98	pyroclastic - spherule	-8,0
2	28/06/00	pyroclastic - spherule	-8,1
2'	28/06/00	2 without sulfides separation	-8,1
3	28/06/00	pyroclastic - paste	-8,2
4	28/06/00	sediment	-7,4
5	28/06/00	sediment	-8,0

Aoba volcano - Voui acidic crater lake (Vanuatu):

Sample	Date	Comment	$\delta^{34}S_s$
V5	?/06/00	spherule	-9,7
V9	?	spherule	-10,1

Kelut volcano (Indonesia):

Sample	Date	Comment	$\delta^{34}S$
V7	?/05/00	alteration (anhydrite+pyrite)	17,5

Kudryavy volcano (Russia):

Sample	Date	Comment	$\delta^{34}S$
a	?	alteration (anhydrite)	5,4
b	?	alteration (anhydrite)	8,2
c	?	alteration (anhydrite)	7,4
d	?	alteration (anhydrite)	6,8
e	?	alteration (anhydrite)	7,1
f	?	alteration (anhydrite)	8,2