SATSUMA IWOJIMA (Japan), MODELING OF THE COOLING OF A HIGH TEMPERATURE GAS PHASE.

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Introduction.

The behaviour of the volcanic gas phase depends on the initial magmatic gas composition and change from one volcano to another, and on a same volcano from one phase of activity to another a fumarole to another. Satsuma Iwojima presents a great variety of high temperature fumaroles, hydrothermal and submarine manifestations. This volcanic islands provides a unique opportunity to study different volcanic manifestation belonging to a same system. In cooperation with the Japan Geological survey we have been able to sample different fumaroles and calculate amodeling of the reaction occuring during the cooling of the high temperature gas emission.

Method Used:

4 fumaroles were sampled using silicatubes in order to collect the condensed phase on the tube wall. Sampling bottles and condensates were connected and analysed by the Japan geological survey (Shinohara and al., 1993 ; Hedenquist and al., 1994).

Using these results it has been possible to recalculate a global gas composition and an atomic balance including major and minor species.

The Simulation Software.

We elaborated a file in the software COACH containing the gases and condensed phase that can form using the atomic balance. This file will serve to the thermodynamic calculations done under GEMINI (Gibbs Energy Minimizer). The calculations are based on the initial atomic retained substance concentrations and are done then on steps of 50°C (Cheynet, 1985).

TABLE 1 - GLOBAL COMPOSITION OF GASES SAMPLED À THE SATSUMA-IWOJIMA

Fumerolle : Ohachi-Oku
Temperature : 877°C
date : 10/24/90

elements		Analysed composition		Recalculated composition
(1) condensates (2) bottle	molecular weight	(1) mg/kg condensed water	mol /100 mol H2O	moles %
B	10.8	10.7	1.8E-03	1.7E-03
F	19	355	3.4E-02	3.3E-02
Na	23	12	9.4E-04	9.2E-04
Mg	24.3	0.08	5.9E-06	5.8E-06
Al	27	1.33	8.9E-05	8.6E-05
Cl	35.5	13 670	6.9E-01	0.676
K	39	2.1	9.7E-05	9.5E-05
Ca	40	0.19	8.6E-06	8.3E-06
Mn	55	0.01	3.3E-07	3.2E-07
Fe	55.8	0.62	2.0E-05	2.0E-05
Cu	63.5	0.03	8.5E-07	8.3E-07
Zn	65.4	0.15	4.1E-06	4.0E-06
As	75	1.74	4.2E-05	4.1E-05
Sr	87.6	0.001	2.1E-08	2.0E-08
Mo	96	0.43	8.1E-06	7.9E-06
Sn	118.7	0.48	7.3E-06	7.1E-06
Ba	137.3	0.003	3.9E-08	3.8E-08
Au	197	1.51^{E}-06	1.4E-11	1.3E-11
Pb	207.2	1.04	9.0E-06	8.8E-06
H_2O		97.5066	100	97.505
S		0.9839	1.01	0.984
CO_2		0.3159	3.2E-01	0.316
H_2		0.4741	4.9E-01	0.474
N_2		8.2E-03	8.4E-03	8.2E-03
CO		1.11E-03	1.1E-03	1.1E-03
O_2		5^{E}-05	5.1E-05	5.0E-05
CH_4		2.8E-04	2.9E-04	2.8E-04
			102.559	100.000

TABLE 2 - ATOMIC BALANCE

elements	Moles number	elements	Mole number
H	195,959	**Ca**	8,3e-06
O	98,138	**Mo**	7,9e-06
S	0,984	**Sn**	7,1e-06
Cl	0,676	**Mg**	5,8e-06
C	0,317	**Zn**	4,0e-06
F	3,3e-02	**Cu**	8,3e-07
N	1,6e-02	**Mg**	5,8e-06
B	1,7e-03	**Zn**	4,0e-06
Na	9,2e-04	**Cu**	8,3e-07
K	9,5e-05	**Mn**	3,2e-07
Al	8,6e-05	**Sb**	2,9e-07
As	4,1e-05	**Ba**	3,8e-08
Fe	2,0e-05	**Sr**	2,0e-08
Pb	8,8e-06	**Au**	1,3e-11

RESULTS OBTAINED

♦ Fumerolle : Ohachi-Oku - 877°C.

827 < T < 877°C	:	Al, B, Ca, Fe, K, Mg, O	(7 elements)
677 < T < 827°C	:	Mg, O	(2 elements)
627 < T < 677°C	:	Cu, Fe, Mg, Mb, O, S	(6 elements)
477 < T < 627°C	:	Cl, Fe, Mb, Na, O, S	(6 elements)
327 < T < 477°C	:	Cl, Fe, O, S, Sn, Zn,	(6 elements)
177 < T < 327°C	:	Cl, Pb, S, Zn,	(4 elements)

♦ Fumarole : Kuromoe - 702°C.

650 < T < 700°C	:	Al, B, Ca, Cu, Fe, K, Mg, Mb, O, S	(10 elements)
600 < T < 650°C	:	FE, O	(2 elements)
500 < T < 600°C	:	Cl, Fe, Mb, Na, O, S	(6 elements)
350 < T < 500°C	:	Cl, Fe, Na, O, Sn, Zn,	(6 elements)
200 < T < 350°C	:	Cl, Pb, S, Zn,	(4 elements)

♦ Fumarole : Ohachi-Oku - 505°C.

450 < T < 500°C	:	Al, Cl, Co, Cu, Fe, K, Mg, Mb, Na, O, S	(11 elements)
300 < T < 450°C	:	Cl, K, O, S, Sn,	(5 elements)
200 < T < 300°C	:	Cl, Pb, S, Zn,	(4 elements)

Solid phases obtained in the calculation will be compared with the solid phases collected on the tube wall.
After validation this method make possible to describe in a model the condensation of the gas phase in the ground, involving the gas rock interaction and the ore deposits genesis as well as the formation of the atmospheric aerosols emitted by the volcano..