Activity report: Hydrological study involving Lake Nyos

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Period: 7th and 8th March 2012

Location: The area surrounding Lake Nyos

1. Sampling of water for hydrological study

   On 7th and 8th , the samples of water were collected at stream, spring, pond which are distributed in the area surrounding Lake Nyos. The list of sampled water is shown in Table 1. The location of sample is shown in Fig.1. The photographs of some of the sampling site are printed in Plate 1 to 4.

2. On the generation of a pond located near Lake Nyos

   According to a Cameroonian field guide, a pond, the name of which is An-nyen-nye, has appeared just after the limnic eruption at Lake Nyos in 1986. There is no stream inflowing to the pond, therefore, the water of pond has been discharged on the floor of pond. The appearance of pond after the limnic eruption suggests that the liminic eruption at Lake Nyos affected the groundwater plumbing system developed near the Lake.

3. Preliminary result

   The isotope ratio of water was measured by use of Picarro L2120-I. The anionic compositon except bicarbonate was analyzed by use of Dionex 900 ion-chromatograph. The obtained isotope ratio is listed in Table 2 and shown in Fig.2. The water dishchaging under the cliff of natural dam is enriched relative to the majority of waters at stream and springs The water from pond (703) and bubbling spring (801) is significantly enriched due to the evaporation effect. The averaged D/H and 18O/16O ratios for the relatively depleted surface water and spring is -13.0 and -3.4 permil to SMOW respectively. The following samples are used to calculate the average: 702, 704, 705, 706, 711, 712, 713, 714, 715, 718, 719, 803. The averaged isotope ratio could be the referece for the local meteoric water (LMW). The d-excess value for the line with slope 8 crossing the LMW is +14.2 permil. The d-excess value is almost identical to the value reported by G. Tanyileke (1994) for the water of stream inflowing the lake.

   The isotope ratio of spring waters (707, 708, 709, 710) is compared with the isotope ratio of lake water in Fig. 3. The enriched isotope ratio of those samples agree with the isotope ratio of lake water shallower than -80m. If the spring water under the

cliff of dam is the leakage of lake water, the above agreement is accepted. The slightly enriched ratios of 802 may be also due to the contamination of leaking lake water.

The bubbling spring water (801) contains sulfate with high concentration reaching 3 mg/L. The pH of 801 is low as 5.2 brought by the carbonic acid, because the spring is bubbling CO2 gas.

The four spring waters (707 to 710) under the cliff of dam would be the leakage of lake water shallower than -80m as suggested by the isotope ratio. The Nyos lake water shallower than -80m contains NO3- ion as more than 1 mg/L. The high concentration in 710 is well consistent to the relationship between D/H and NO3- concentration found at the lake water in 2012 (Fig.4). However, no NO3- is detected in 707 and 708, suggesting a possible denitification process may work in the channel through which the Nyos lake water is leaking.

References

G. Tanyileke (1994) Fluid geochemistry of CO2-rich lakes and soda springs along the Cameroon volcanic line, Cameroon, Doctoral thesis, Okayama University

Table 1. The temperature, pH and the location of water samples for hydrological study.

Code	Date	Temp.	pH	Latitude	Logitude	Description
	yyyy/mm/dd	C		degree (North)	degree (East)	
701	2012/3/7	20.7	8.2	6.46664	10.29464	Water of stream
702	2012/3/7	21.6	8.1	6.45700	10.27303	Water of stream
703	2012/3/7	21.8	6.6	6.45678	10.27192	Water of pond (An-nyen-nye)
704	2012/3/7	20.3	7.7	6.45853	10.27697	Water of stream
705	2012/3/7	23.9	6.4	6.45464	10.29867	Source spring water, Lava spring (right)
706	2012/3/7	23.7	6.3	6.45464	10.29867	Source spring water, Lava spring (left)
707	2012/3/7	20.0	8.0	6.44558	10.29447	Spring water under the north cliff of Lake Nyos
708	2012/3/7	20.7	8.2	6.44558	10.29447	ditto
709	2012/3/7	20.0	8.0	6.44558	10.29389	ditto
710	2012/3/7	20.0	7.9	6.44567	10.29392	ditto
711	2012/3/7	20.6	8.0	6.44042	10.29225	Water of stream flowing into lake Nyos
712	2012/3/7	21.0	8.5	6.43975	10.29258	ditto
713	2012/3/7	21.0	8.0	6.43661	10.29319	ditto
714	2012/3/7	22.2	7.9	6.43606	10.29350	ditto
715	2012/3/7	20.5	7.7	6.43239	10.29564	ditto
716	2012/3/7	24.3	7.6	6.42950	10.29983	ditto
717	2012/3/7	23.0	7.0	6.42842	10.30094	ditto
718	2012/3/7	21.8	6.9	6.42842	10.30261	ditto
719	2012/3/7	22.0	7.8	6.43036	10.30411	ditto
801	2012/3/8	25.0	5.2	6.45000	10.30558	CO2 gas bubbling spring
802	2012/3/8	23.4	8.0	6.44369	10.30700	Water of stream flowing from lake Nyos
803	2012/3/8	18.3	7.7	6.44369	10.30714	Water of stream

Table 2. Isotope ratio and anionic compositon of water sampled around Lake Nyos in March 2012.

Code	δD_{SMOW}	$\delta {}^{18}O_{SMOW}$	F	Cl	Br	SO4	NO3	NO2
	(‰)	(‰)	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
701	−10.44	−2.82	0.11	0.40	ud	0.24	ud	ud
702	−13.93	−3.85	0.21	0.16	ud	0.17	ud	ud
703	−0.70	−1.19	0.13	0.47	ud	0.05	0.006	ud
704	−13.07	−3.33	0.19	0.21	ud	0.22	ud	ud
705	−12.07	−3.02	0.13	0.38	0.072	0.31	0.064	0.022
706	−11.96	−3.04	0.14	0.36	ud	0.26	ud	ud
707	−6.04	−1.88	0.07	0.27	ud	0.01	ud	ud
708	−6.38	−1.91	0.07	0.23	ud	0.00	ud	ud
709	−7.90	−2.17	0.10	0.34	ud	0.10	0.077	ud
710	−6.58	−1.97	0.05	0.27	ud	0.29	3.2	ud
711	−14.62	−3.56	0.20	0.48	ud	0.44	ud	ud
712	−13.81	−3.44	0.24	0.32	ud	0.31	ud	ud
713	−11.35	−3.20	0.24	0.04	ud	1.11	ud	ud
714	−14.81	−3.59	0.40	0.10	ud	0.41	ud	ud
715	−14.63	−4.06	0.20	0.14	ud	0.14	ud	ud
716	−11.38	−2.99	0.05	0.07	ud	0.03	ud	ud
717	−12.82	−3.31	0.06	0.11	ud	0.05	0.80	ud
718	−11.12	−3.09	0.04	0.05	ud	0.08	ud	ud
719	−14.54	−3.63	0.06	0.02	ud	0.02	ud	ud
801	−5.04	−2.44	0.06	ud	ud	3.03	ud	ud
802	−9.05	−2.40	0.10	0.45	ud	ud	ud	0.0057
803	−13.36	−3.35	0.04	0.16	ud	0.04	ud	ud

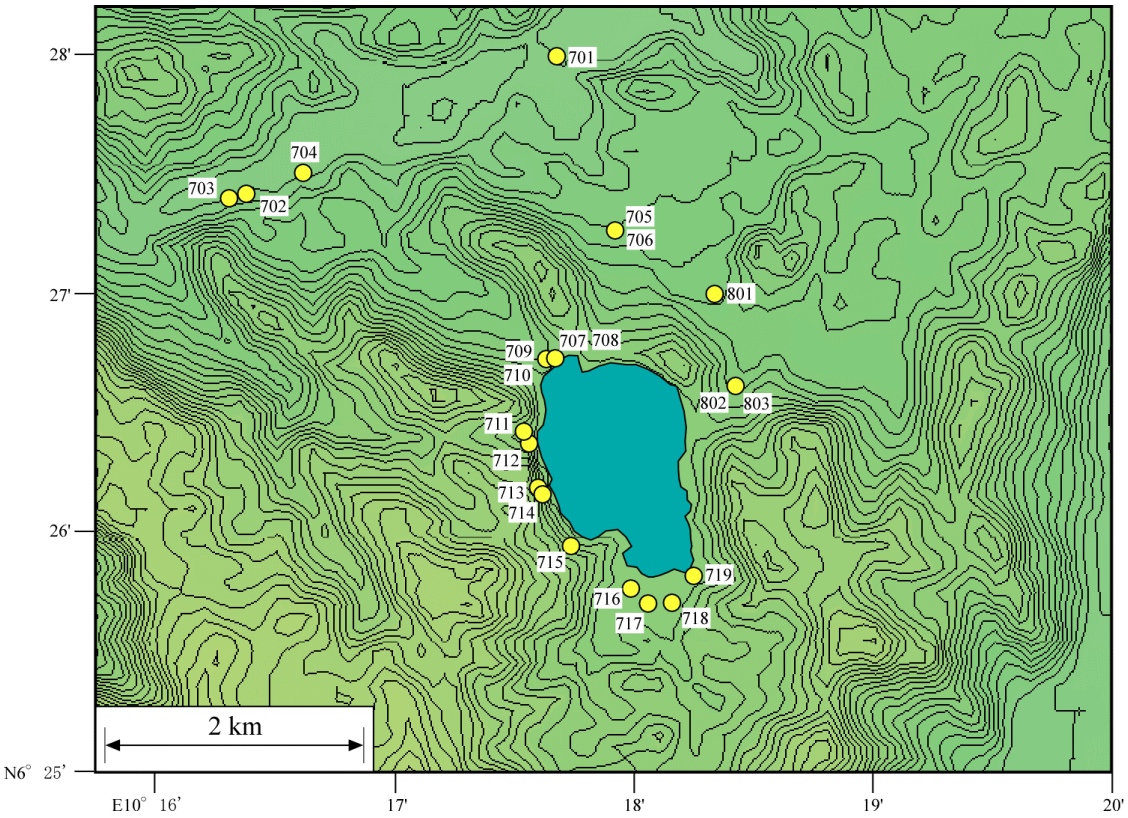

Fig.1 Location of the waters sampled on 7th and 8th March 2012

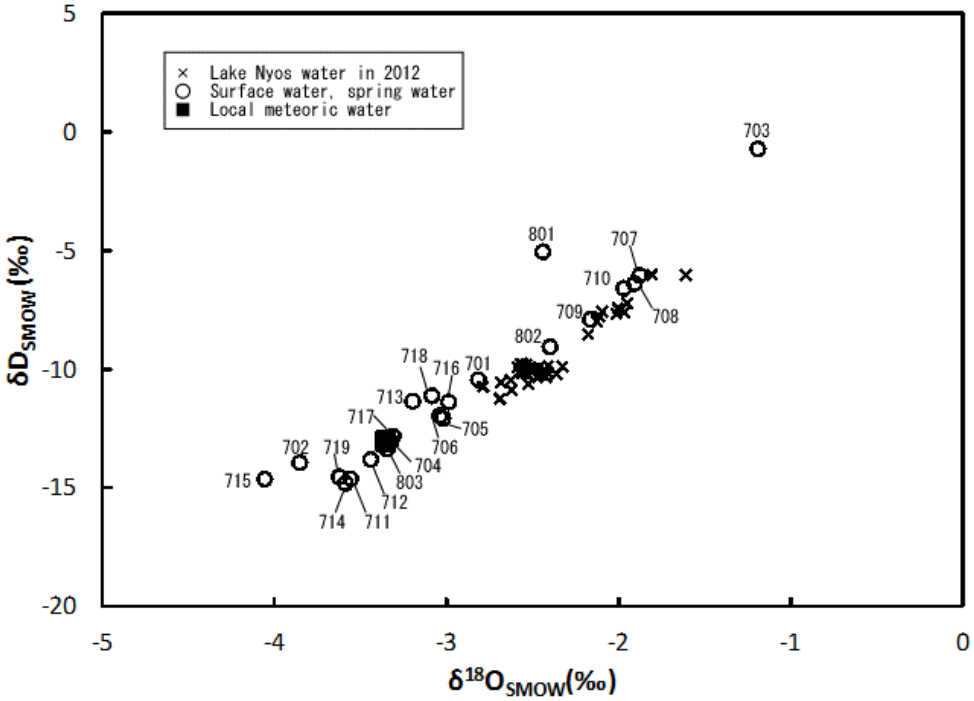

Fig. 2 Isotope ratio of water in stream, spring and Lake Nyos in 2012. The local meteoric water is the average of water in stream and spring with no effect of Lake water.

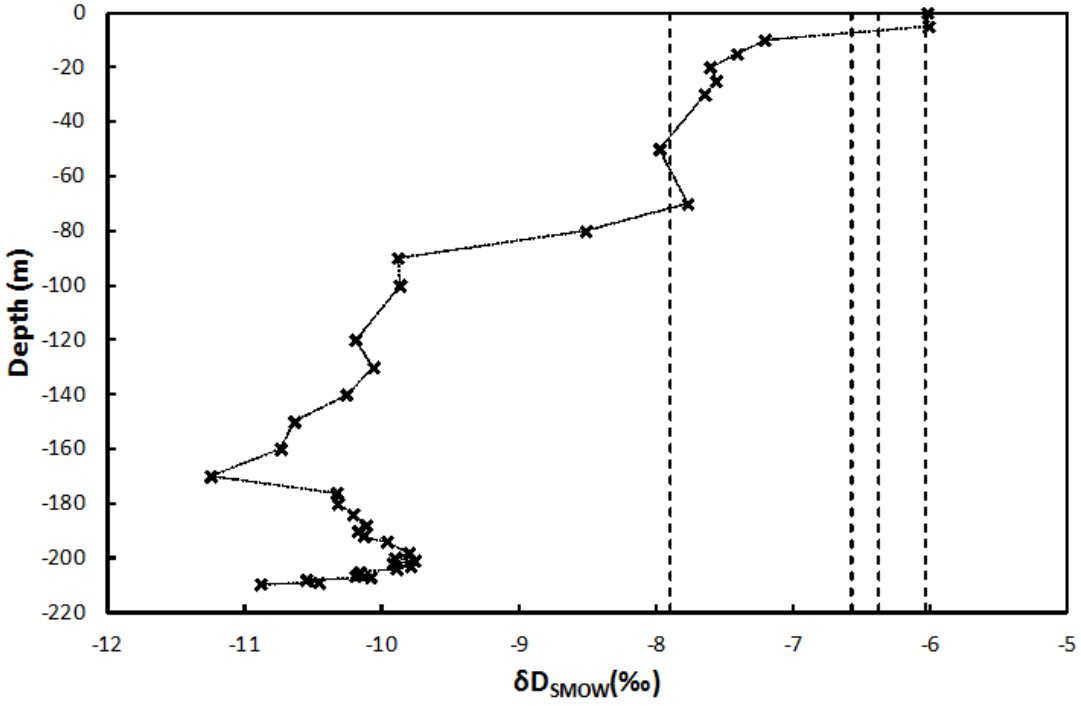

Fig.3 D/H ratio of water in Lake Nyos (x) and the water under the cliff of dam (dashed vertial lines).

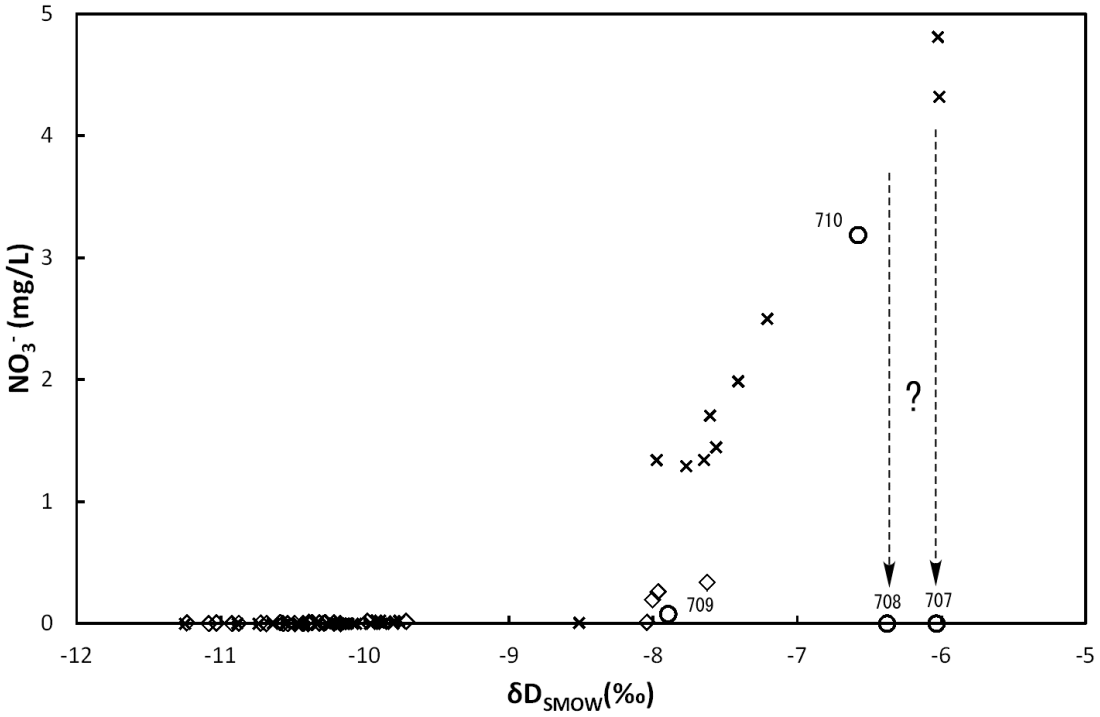

Fig.4 D/H ratio of Nyos lake water in 2012 (x) and 2011(diamond). The spring water under the cliff of dam (circles) are plotted. The dashed arrows mean a possible denitification process explaining the no NO3- in the water of 707 and 708.

Plate 1. The pond, An-nyen-nye (sample code: 703)

Plate 2. Spring water (705 and 706)

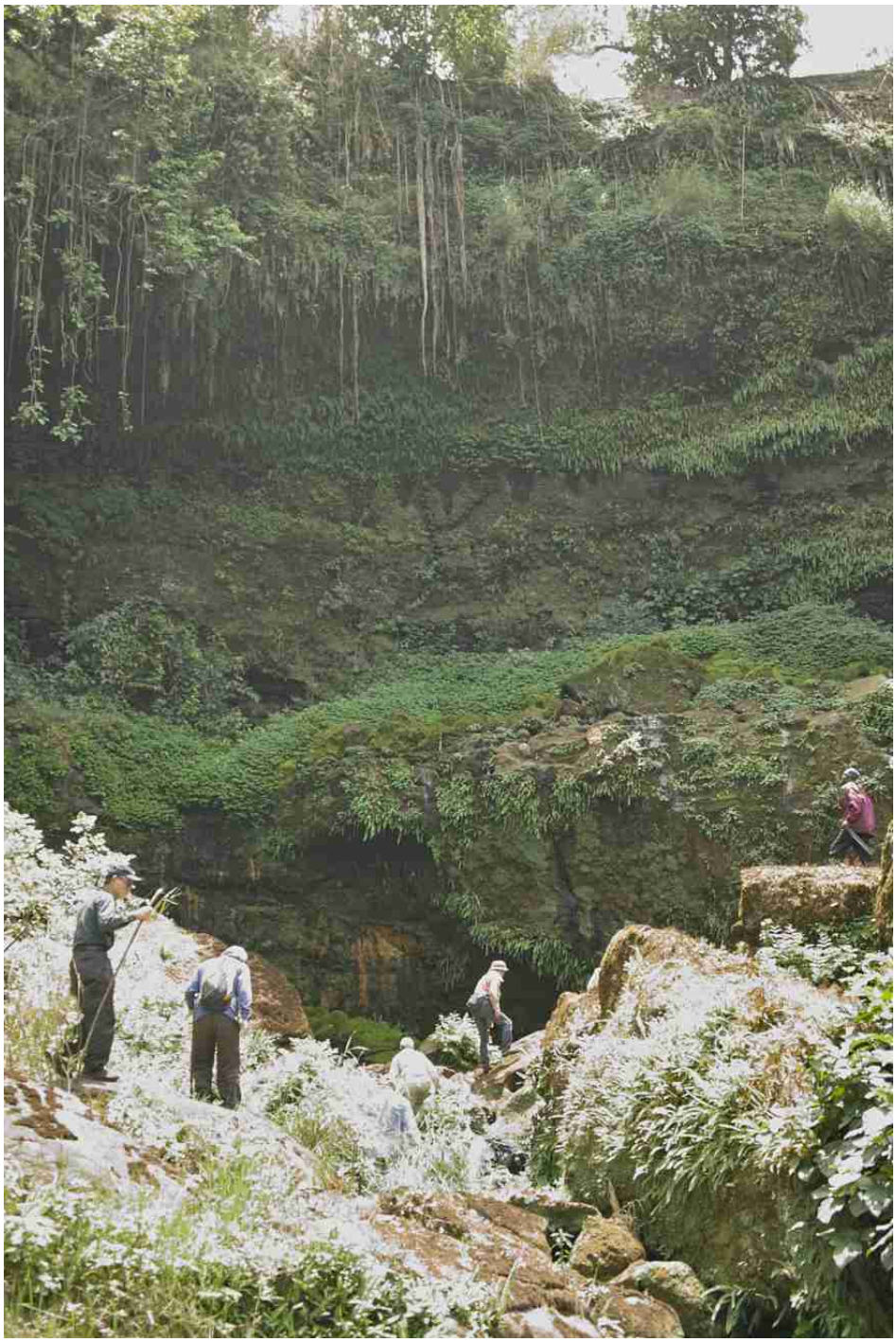

Plate 3. The wall of natural dam

Plate 4. Spring water (707 to 710)

Plate 5. Bubbling spring water (801)