ARSENIC MINERAL SPRINGS AT TIBET

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ABSTRACT

This paper will deal with arsenic mineral springs, one of the medical mineral springs, at Tibet. It looks as if Tibet is a sole region discharging arsenic springs in all over the country. Based on the chemical data of 259 thermal springs at Tibet, we checked up 51 arsenic springs according to the standard of medical springs issued on Qingdao Academic Conference in 1982.

1. WHAT IS THE ARSENIC MINERAL SPRING?

On the Qingdao Medico-Convalescent Academic Conference in 1982, the medical mineral springs in China have been classified into 12 types and arsenic spring is one of them. The lowest index of arsenic content of these springs is 0.7mg/L. The medical action of arsenic spring rests with arsenic element with most important function in human organism. The jointed affinity of arsenic with organic sulphur is very big, so it lays in sulphur-rich organs, such as skin, liver etc.. Due to the affinity of arsenic with organic sulphur is the foundation of its role in an organism, the action of arsenic element is shown at the metabolism. Arsenic will reduce total metabolism in order to control oxidation. Also arsenic hinders the metastasis of hydrogen, thus the activity of vitamin D is much weakened. Moreover three-valence arsenic element possesses resistance to thyroid gland. Some thought that arsenic is an antidote against thyroid gland poisoning. Arsenic is imbued with stockpiling function to increase glycogen in liver or muscle and to put on weight thereby. Arsenic has an obvious inference for forming of blood and its effect is similar to iron, but arsenic is a stimulus and is not a component part of blood making. Arsenic is an exciter for function of marrow. Arsenic can increase the elasticity of skin and absorption of arsenic can take place an obvious hyperemia of mucosa（Wang Limin et al., 1993）.

2. ARSENIC MINERAL SPRINGS SPREAD ALL OVER TIBET

The report about arsenic springs in China is very few, but the fact, there are many arsenic springs in Tibet, not yet brings to people's attention. According to investigation of Geology Department of Peking University（Tong wei et al., 2000）, total thermal springs in Tibet is about 677, including traces of spring 24, thus active thermal springs are 653. The thermal springs on-the-spot investigation by Tong Wei and his colleagues of Geothermal Research Group of Peking University are 354, of which 259 springs had water samples（Tong Wei et al., 1981）.

The chemical nature of arsenic element in water phase is more complex and interesting, displaying on the oxidation-reduction, exchange of coordinating group, precipitation, absorption and so on. Under different electric potential Eh, arsenic in water phase has four stable oxidation modes: positive 5-valence, positive 3-valence, zero-valence and negative 3-valence. When oxygenated water is provided with high Eh value, each of arsenic acid （H_3AsO_4, $H_2AsO_4^-$, $HAsO_4^{--}$. AsO_4^{---}） has stable. Each of arsenious acid （H_3AsO_3, $H_2AsO_3^-$, $HAsO_3^{--}$） under weak reductant also is stable. Arsenic in water of thermal springs most likely takes H_2AsO_3 and H_2AsO_4 as chief existence. In the book 《Geothermics beneath Tibet》, the sigh "As" expresses arsenic element. The determination of As has used by absorption-colorimetric analysis.

Analysis of total 259 samples at Tibet was conducted in laboratory of Geothermal Research Group of Peking University and arsenic content of 55 samples of them can not be detected out. Sample of As content in exceed of 0.7mg/L （i.e. arsenic mineral spring）has 51 springs, but only 13 of which have been repeatedly detected in different years. The highest value was 125.6mg/L in Molojang of Gar County of Ngari Prefecture.

As content of thermal springs in volcano-thermal region of whole world fluctuate between trace and several mg/L （White et al., 1963）. The highest As content of some thermal springs in Japan is 25.7mg/L（Hirakawa et al., 1977）. Thus the abundance of As of certain thermal springs at Tibet is so much that was seldom heard in the whole world. The orpiment minerals were found in the silica sinter, travertine or soil of some hydrothermal regions at Tibet. The interrelationship between As and Cl in NaCl type or HCO3-Cl type waters at Tibet is fairly distinct.

Table 1 Arsenic springs at Tibet are given in following table.

No	Name of As spring	County	Longitude deg. min.	Latitude deg. min.	Temperature of spring ℃	Cl content mg/L	As content mg/L
1	Molojang	Gar	80 25.27	31 21.00	85.5	1560	125.6
2	Saimi	Ngamring	86 32.17	29 13.00	86	674	30.80
3	Kunggyu	Purang	82 06.08	30 42.67	71.5	76.2	22.49
4	Qudowa	Gegyai	82 36.13	31 58.62	61	639.1	20.00
5	Chabmaisa	Qusum	92 14.00	29 13.83	75	4212	19.86
6	Daba	Chagyab	98 03.50	30 34.67	52	242.7	13.2
7	Cala	Ngamring	87 18.58	29 34.42	52.5	92.7	11.8
8	Lungju	Gar	80 21.67	32 21.80	78	430	6.50--9.00
9	Lhabulang	Ngamring	86 32.10	29 12.83	85	707.4	5.66
10	Daggyai	Ngamring	85 44.75	29 36.17	85.5	165	5.40--5.50
11	Dazho	Amdo	91 24.00	32 51.17	73	276.5	4.98
12	Namru	Gar	80 09.93	31 55.28	85	179	4.13
13	Loinbo	Ngamring	87 27.00	29 24.42	65.2	272	4.00
14	Capu	Xaitongmoin	88 24.00	29 45.50	86	285	3.65--2.20
15	N. Qagarba	Namling	89 26.13	29 36.53	70	195.9	3.30
16	Buloba	Ngamring	87 09.13	29 23.87	79.8	693	3.05
17	S. Qagarba	Namling	89 25.00	29 36.00	77.5	206	2.97
18	Sagalungga	Comai	91 54.83	28 31.00	85	626	2.61--2.80
19	Babudimi	Comai	91 55.17	28 32.33	86.5	579	1.09--2.41
20	Buxunglungu	Comai	91 52.92	28 31.00	86.5	759	2.20--2.41
21	Yangbajain	Damxung	90 30.00	30 04.67	90.5	468	2.15--2.40
22	Chaka	Biru	93 16.25	31 31.40	68.5	1070	2.13
23	Gogoqung	Xaitongmoin	88 08.08	29 21.50	63.2	693	1.49--1.90
24	Zelegbo	Gegyai	81 22.50	31 24.30	20	50.6	1.88
25	Yangyi	Damxung	90 22.28	29 44.25	91.5	183	1.82
26	E. Chaka	Comai	91 54.50	28 31.90	64	549	1.80
27	Chaggar	Xaitongmoin	88 41.75	29 42.58	51	256	1.78
28	Sangmosai	Namling	89 26.25	29 38.73	84.5	167	1.73
29	Deiba	Mangkam	98 24.00	29 37.50	50.5	243	1.70
30	Qangba	Gegyai	80 41.45	32 32.73	51	381	1.68
31	Qucain	Damxung	90 56.67	30 24.77	91	512	1.672--0.22
32	Xirug	Xainza	88 47.72	30 47.10	35.5	532	1.64
33	Marzo	Nyima	86 41.58	31 28.47	50	1020	1.60
34	Chaka	Comai	91 54.00	28 31.42	84	573	1.54--1.34
35	Sertang	Namling	89 23.33	29 54.00	81.2	118	1.502--0.73
36	Rutog	Maizhokunggar	92 14.33	29 41.83	81.5	168	1.34--1.352
37	Yangbam	Nyainrong	92 34.50	32 17.50	31	226	1.32
38	Chaggar	Namling	89 37.00	29 32.72	26	208	1.22
39	Zhexilong	Qamdo	97 11.67	31 04.00	26	32.5	1.21
40	Chanyi	Baqen	93 55.75	32 22.00	73	574.6	1.15
41	Chamqen	Bome	95 02.33	30 04.17	94	4.52	1.10
42	Xongqun	Xainza	88 43.70	30 50.78	51.5	328	1.07
43	Cochama	Qamdo	97 06.33	31 24.00	27	8.68	1.06
44	Qoichi	Chagyab	96 37.75	30 04.17	63	134	0.993
45	Golug	Nagqu	91 36.50	30 52.42	85	899	0.99
46	Chaqugoin	Maizhokunggar	91 10.33	30 07.00	85	318	0.985-0.705
47	Chalung	Biru	93 30.55	31 29.00	43	253	0.915
48	Zexoi	Namling	89 02.33	29 51.13	40	846	0.88
49	Xungba	Ngamring	87 04.67	29 47.67	43	152	0.82
50	Dargarma	Nyainrong	92 51.67	32 22.50	52	70.7	0.73
51	Oiga	Sangri	92 18.92	29 23.42	62	50.4	0.70

The distribution of arsenic springs at Tibet is shown on the map.

We are sure that the amount of arsenic spring at Tibet must be exceeded 51 due to want of chemical proof for about 300 thermal springs. A vast amount of arsenic springs discharged on Tibet, there's nothing strange about it. Owing to convergence of both Eurasian plate and Indian plate, Tibet is a most active region for crustal disturbance, where remelting of continental crust took place. The enrichment of As element could be related to remelting magmanism.

3. DISCUSSION:MEDICINAL SPRING OR POISONING SPRING

Arsenic element was found by Albertus Maghu（1193-1280, a German）in 1250 and made by heating of auripigment plus soap. Aderholdt detected As from plant in 1852 and Rees found As from animal in 1834. Arsenic element also exists in the human body. For the content of As that absorbed from food, if it is 0.07mg/day that is not enough; value with 0.04-1.4mg/day is normal; content with 5-50mg/day could be able to poison; and value with 50-340mg/day can cause death. The ancients in china can use arsenic preparation in many secret recipes.

Arsenic spring can enter in a list of medical spring due to the blood making function of arsenic and to promoter of growing of tissue cell. Its target is 0.7mg/L, but there isn't upper limit（Wang Limin et al., 1993）. It warrants careful consideration. Arsenic element accompanying food, water, smoking, and air can be absorbed by alimentary canal, respiratory tract and skin into human body and can be discharged from urine. Man is absorbent of As about 0.9mg each day. An excessiveness can cause acute poisoning with symptoms of fever, sick of eating, swell of liver or kidney, arrhythmia and enterogastritis etc. or can arouse slow poisoning showing as dermatitis, cutaneous cutin, vasculitis, and sclerosis of liver or kidney. Arsenic can lead up to distortion of mammal's chromosome. Data of epidemiology proved that an inorganic arsenic is carcinogenic source of human, which can bring out cancer of skin or lung, or haemangioma（Jiang Quanguang,1995）.

According to the rules of food in our country, the quantity of allowing absorption of arsenic is 0.025- 0.33mg for every kg body weight（Tu Tongjin, 1992）. But As content in arsenic springs at Tibet is so high as to be unable to use for batting or drinking.

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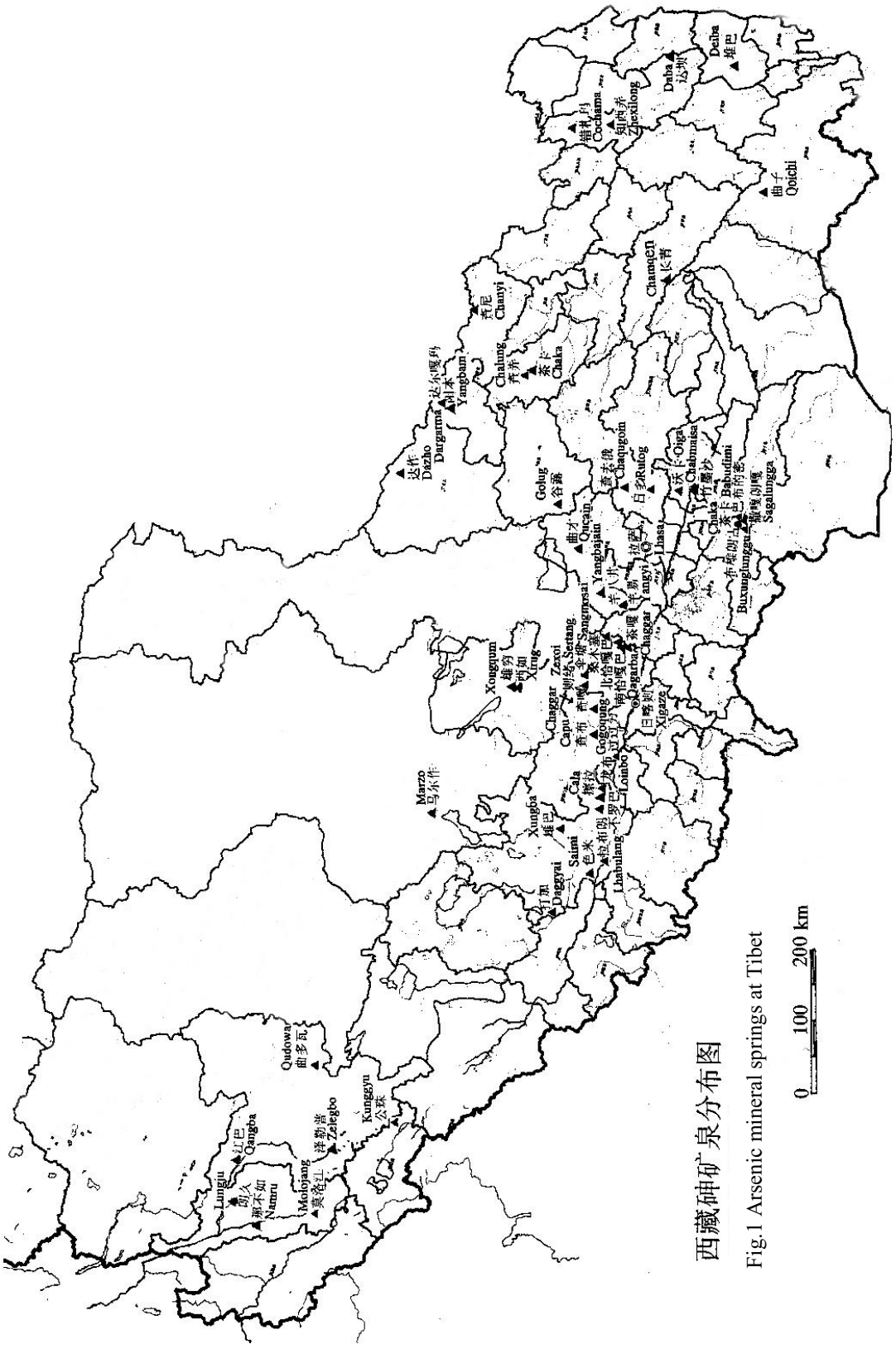

西藏砷矿泉分布图

Fig.1 Arsenic mineral springs at Tibet