THE INTRUSION OF GEOTHERMAL WATER INTO DOMESTIC GROUNDWATER IN CHIANG MAI BASIN, NORTHERN THAILAND

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Abstract

The similarity in chemical species of some domestic groundwater in the eastern part of Chiang Mai basin and thermal spring water were noticed during the investigation for the cause of fluorotoxicosis in Northern Thailand. The major elements except silica such as sodium, fluoride, calcium, magnesium and iron are showing the same trend and against those of normal groundwater. The effect areas located parallel to the Mae Tha fault zone and show the direction intercept with thermal spring system. The intrusion of thermal water into these domestic groundwater were suggested via underground fractures and faults which related to the thermal spring system.

The isotopic study show the contaminated water have their isotopic ratio trending toward the thermal spring water indicated the origin of these water similar to those of thermal springs but at a lower mixing ratio.

Extended Synopsis

Chiang Mai basin in northern Thailand is a structural basin surrounded by mountain ranges, covering and area of approximately 2,500 km. with 25 km. width in E-W direction and 100 km. length in N-S direction (Figure 1). The sediments composed of approximately 1,200 m. thick semiconsolidated Tertiary fluviatile and 100 m. thick unconsolidated Quaternary alluvium deposits, lying unconformably upon the Paleozoic rocks. The water qualities of Chiang Mai and Lumphun area were studied to find the relationship with the fluorotoxicosis cases found in Chiang Mai Hospital and with the thermal springs discharged into the surface runoff system. They were concluded that the thermal springs discharge had no direct relation with the background of the patients and thus the intrusion of thermal water into domestic groundwater[1] were suspected.

Groundwater qualities in Chiang Mai basin is divided into sodium-calcium-bicarbonate and calcium-sodium-bicarbonate facies. The relationship between the groundwater in the eastern part of the basin with the San Kamphaeng geothermal system are strongly structural controled as suggested by faults and the fluoride ion contamination in the domestic groundwater (Figure 2). The faulting systems under the unconsolidated sediments are suspected to be the passage ways for the intrusion of thermal water into the domestic groundwater in the eastern part of the basin and parallel to the Mae Tha fault zone. Apart from the structural controled, the other geological events such as microearthquakes (below 4 on ritchter scale) which has been pronounced in this area in 1978. The effect was noticed on concentration of fluoride ion which were as high as 100 ppm. in thermal springs, 30-40 ppm. in the contaminated groundwater, whereas the saturated water in the fluorite mine was only 25 ppm.[2]

The isotopic data on deuterium, oxygen-18 and tritium (Figure 3) indicated the contaminated water have the same origin of thermal water.[3] They were thought to be the meteoric water which derived from higher altitude and/or mixing with long circulation thermal water of meteoric origin. The different of these contaminated groundwater is only mixing with a lower proportion.

Acknowledgement

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References

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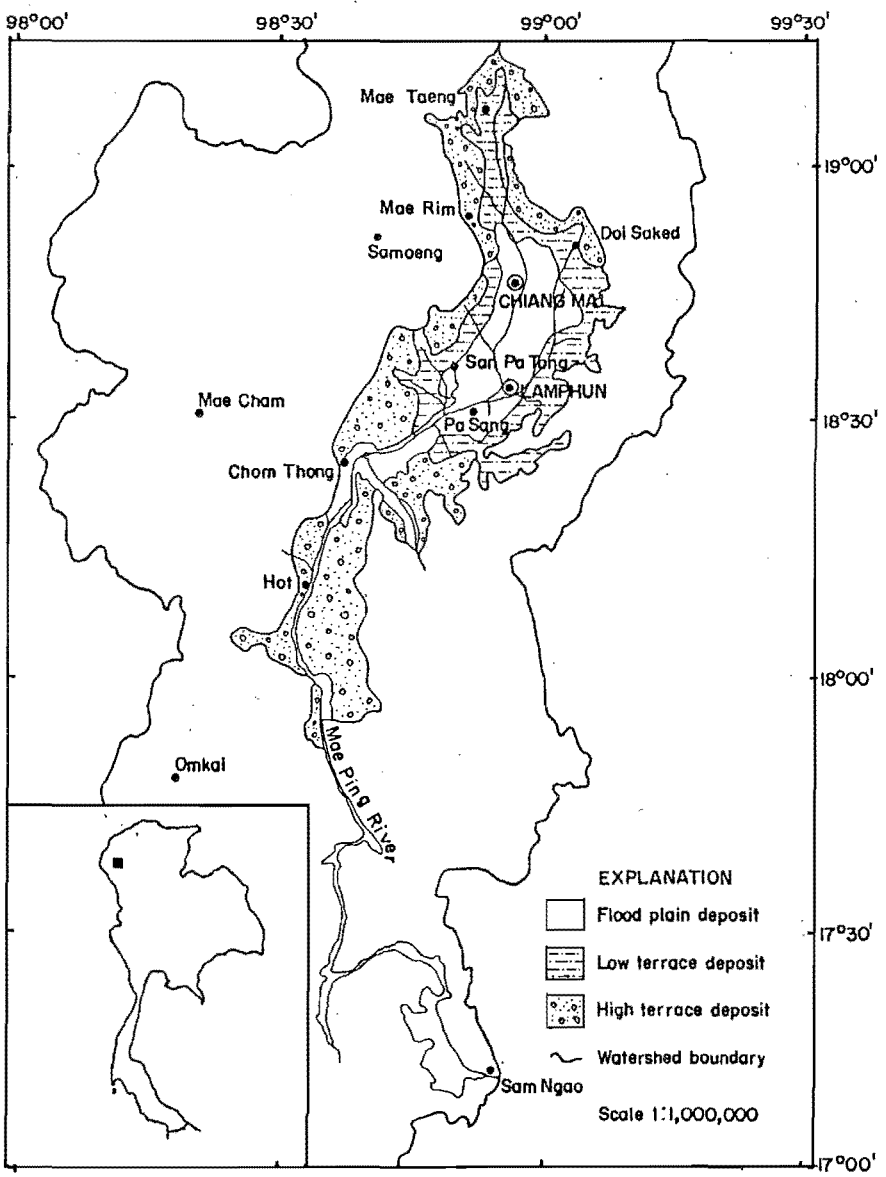

Fig. 1 Chiang Mai Basin, Northern Thailand

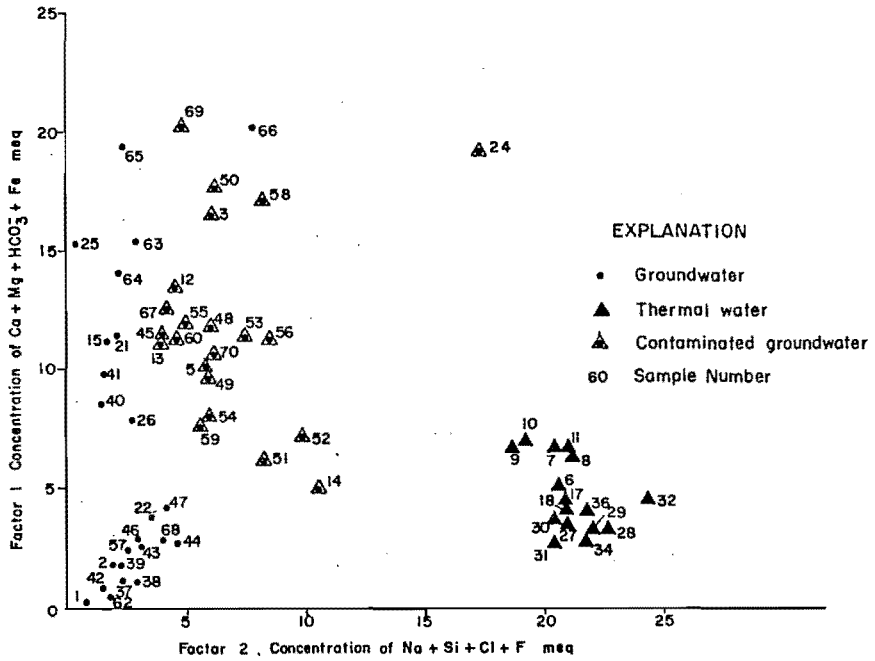

Fig. 2 Chemical analysis of groundwater and thermalwater in Chiang Mai Basin

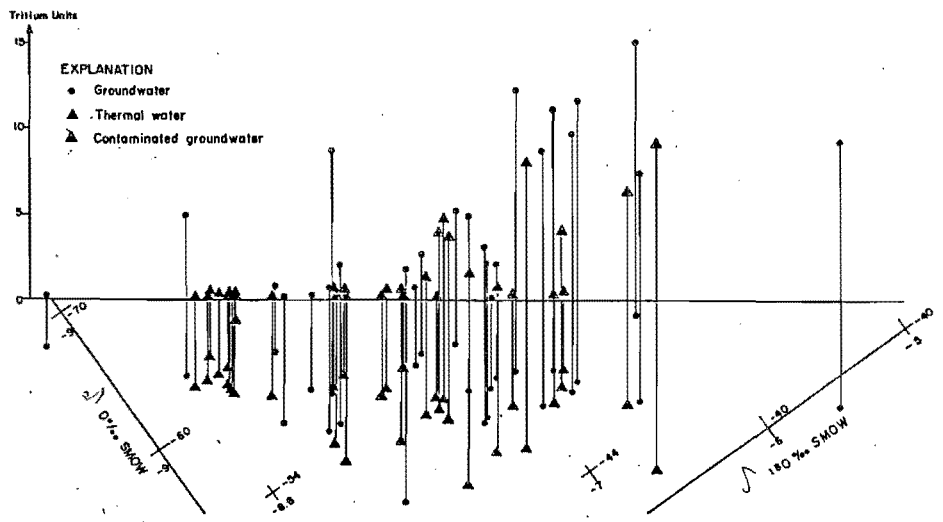

Fig. 3 Plot of data oxygen - 18 against delta deuterium and project on the value of tritium units. The isotope values suggest the thermal water, groundwater and contaminated groundwater derived from the same origin.