INTER-OFFICE MEMORANDUM

Date: January 9, 1973

To: Files

From: F. Dellechaie

Subject: A Preliminary Hydrogeochemical Report on Eight Thermal Springs from the Mt. Princeton Area, Chaffee County, Colorado.

cc: W. M. Dolan
R. F. Horsnail
A. L. Lange
H. J. Olson
P. D. Parker

Introduction and General Geology

This is a preliminary report on seven water samples collected in the Mt. Princeton area, Chaffee County, Colorado. Two analysis of thermal spring water from the same area were taken from Sharp (1970) and are also included. The writer plans to sample all thermal springs in the Mt. Princeton area during the third week of January and will submit a final report shortly afterward.

The Mt. Princeton area is part of the Upper Arkansas Graben, a fault-bounded basin located at the northern end of the Rio Grande Rift zone. The prospect area is underlain by the Mt. Princeton Batholith, dated at 27 to 30 M.Y. old, and is one of the largest intrusive masses in the continental United States. The Arkansas Graben was infilled with clastics during the Miocene and Pliocene; these interlayered shales and sandstones constitute the present day Dry Union Formation, some 3000 to 5000 feet thick. The majority of thermal springs are associated with Cottenwood and Chalk Creeks which are thought to be manifestations of northeast-southwest transverse faults to the Mt. Princeton Batholith.

Chemistry

All samples exhibit a basic pH between 7.8 and 8.9, low chloride, high fluoride and boron (Sharp, 1970); with the exception of samples x74372 and x74534, samples fall below the established 15 ppm chloride level which indicates a water-vapor or vapor dominated reservoir. High concentrations of fluoride and boron are found at the Geysers and Larderello fields, both vapor dominated systems; overall, these waters are similar to an analysis of Magnesia Springs, Sonoma County, California.

Silica concentration ranges between 50 and 72 ppm, indicating subsurface temperatures between 98° and 118°C. Subsurface temperatures indicated by the $Na/_K$ atomic ratios range from 65° to 115°C. Reservoir temperatures indicated by the Na-K-Ca thermometer are highest of all, ranging from 80° to 270°C. The Na-K-Ca temperature for sample X74533 is unrealistically high because of the large calcium concentration it contains. There seems to be good agreement between silica, $Na/_K$ and in three cases Na-K-Ca geothermometers. The temperatures listed in Table 1 are in good agreement with a well drilled on the Young Life property just south of Hortense Hot Spring where a temperature of 158°C and flashing in the bore hole were observed at 172 feet.

The high $Na/_{Mg}$ and $Mg/_{Ca}$ atomic ratios (sample X74533 has a low $Na/_{Ca}$ ratio) qualitatively indicate high subsurface temperatures. The low $Cl/_F$ atomic ratios may indicate the presence of a vapor phase, however, this relationship is not empirically founded.

Low magnesium and calcium concentrations are found in all samples except X74533 and qualitatively indicate high subsurface temperatures because these elements exhibit low solubility at high temperatures and vice versa.

Discussion

The thermal waters of the Mt. Princeton area exhibit characteristics of both hot water and vapor dominated systems. The writer feels that these waters contain a portion of condensate from an underlying wet or dry steam reservoir which issues up through faults in a capping horizon. The remainder of the thermal waters belong to a ground water system that exists above the capping horizon and is heated by the conducting capping horizon.

Frank Dellechaie

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