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CRYSTAL GEYSER, UTAH: PETROGRAPHIC ANALYSIS OF ACTIVE TRAVERTINE DEPOSITS OF A COLD-WATER, CARBON DIOXIDE DRIVEN GEYSER

Most travertine deposits are typically the result of spring-fed waters depositing calcium carbonate derived from the dissolution of limestone bedrock. While these deposits may be quite complex and vary significantly from one another, the circumstances under which they are deposited are fairly common. The travertine deposits of Crystal Geyser are unique in that they are not the result of typical circumstances. Crystal Geyser is located 9 miles southeast of the town of Green River, Utah, and is situated on the bank of the Green River. It is unusual because it is not a naturally created geyser, it erupts only cold water, and its eruptions are driven by the degassing of large volumes of carbon dioxide. The geyser was created in 1936 when an exploratory oil well was drilled to a depth of 800 m and, consequently, tapped into a carbon dioxide charged aquifer at around 215 m (Waltham, 2001). Part of the well pipe stands about 2 m above ground (Figure 1). Since that time, it erupts periodically while expelling large quantities of carbon dioxide and travertine-depositing water. Due to this unusual phenomenon, many studies have been conducted at this site to further research the concept of carbon dioxide sequestration (Heath, 2004; Dockrill, 2005; Williams, 2005; Allis, 2005; Allis, 2001.) Dockrill (2005) provided a field description and brief petrographic analysis of the travertine deposits along with geochemical data. Heath (2004) also conducted some geochemical analysis. These studies, though, were solely related to furthering carbon dioxide sequestration research and had little interest in the rock itself. Due to the extremely unusual

circumstances leading to the development at Crystal Geyser, it is believed that a full and detailed study of the travertine at this site should be conducted.

***Figure 1**: Exploratory well pipe at the top of the active travertine deposit. Runoff indicates where the deposit begins to dip down towards the partially frozen river. The row of trees indicates where the opposite river bank is located.*

The maximum diameter of the active travertine deposit is approximately 85 m. The nature of the active travertine varies at any given location. Near the well, the travertine is relatively flat lying and is heavily iron-oxide-stained. It is extremely brittle. Small, white bulbish features have precipitated on sites that frequently remain submerged. Down slope, the travertine is more porous and spongy, sometimes incorporating vegetation. It forms bright orange, red, and yellow steep terraced mounds, which are ornamented with a myriad of micro-terraces (Figures 2, 3). These deposits combine to form large lobes, which fan towards the river. Micro-terraces form small rimstone pools in which water accumulates. Doelling (1994) and Dockrill (2005) mentioned that algae may be affecting some of the precipitation of this young deposit. Dockrill (2005) also identified what he believed were calcite shrubs (Chafetz and Folk, 1984), which are bacterially induced deposits.

The active travertine lies atop or immediately adjacent to older carbonate deposits, whose ages are unknown, but are believed to be the result of fault-derived fluid flow (Doelling, 1994). These deposits, therefore, are likely spring-fed and are not related to any geyser activity. They are crudely laminated and have undergone severe weathering. Older deposits display large veins of calcite or aragonite.

***Figure 2**: Terraced mound of active travertine immediately adjacent to an older deposit.*

***Figure 3**: Close-up of micro-terraces.*

Reconnaissance sampling of the active deposit and one section of an older deposit were conducted in January of 2010. Samples were collected from the areas not covered by snow. A return trip is planned for more detailed investigation and sampling. Samples collected will undergo petrographic, mineralogical (XRD), elemental (ICPMS), and stable isotopic (mass spectrometer) analyses. A scanning electron microscope (SEM) will be used to characterize both abiotic and biotically induced precipitates.

To date, only cursory research of the travertine at Crystal Geyser has been conducted, and any documentation of similar sites has not been found. It is, therefore, concluded that this is an atypical site with very unique circumstances for travertine precipitation. It is believed that Crystal Geyser travertine will display some very unusual characteristics. This research will provide an in-depth description of this unusual deposit and also shed some insights into the origin of other carbonate accumulations.

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