The Chess Draw depression, Otero CO., New Mexico: A hydrothermally-altered, sublaccolithic, alkalic system

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in:

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INTRODUCTION

The alkaline intrusives on the north central Diablo Plateau, known as the Cornudas Mountains are prominent and erosionally resistant hills. They can be seen north of the Highway 180 between El Paso and Carlsbad. These plugs, laccoliths and sills have been radiometrically dated to be 33 to 37 million years old and have been subjected to numerous other geological, geochemical and petrologic studies (Barker and Hodges, 1977; Barker et al., 1977; Henry and McDowell, 1986; Price et al., 1986; McLemore and Guilinger 1993, 1996; McLemore et al., 1996; Nutt and O'Neil, J., 1998). This group of intrusives bears some resemblance to those near the Sierra Blanca, Texas, 90 km to the south. Sierra Blanca contains proven resources of beryllium (Henry, 1992; Price et al., 1990; Shannon and Goodell, 1986; Matthews and Adams, 1986; Setter and Adams, 1986). A dike containing abundant eudialyte, Na₉Ca₉(Fe,Mn)₄Zr₄(Si₂O₇)(OH,HO)₃, and other Zr minerals (catapleiite, Na₉SrSi₅O₁₀(H₂O)), and georgechaoite, NaKZrSi₅O₁₀(H₂O) at Wind Mountain (Bogg and Ghose, S. 1985), in addition to parakeldyshite, Na₂ZrSi₅O₁₀ (McLemore et al., 1996), also attests to the high REE and Zr potential of the area. This deposit also displays similarities to the fluorite-REE deposits in the Gallinas Mountains of Lincoln County, New Mexico.

Gold is another resource sometimes associated with alkali rocks. A gold deposit with an alkaline intrusive association is located at White Oaks, New Mexico, approximately 195 km north of the area (Fulp and Woodward, 1991). Since REE and Au deposition are sometimes associated with alkaline magmatism (Fulp and Woodward, 1991; Kogarko, 1990; Mutschler et al., 1991; Woodward and Fulp, 1991; Wyman and Kenrich, 1989), additional research on any igneous rocks in the region (especially on poorly exposed rocks such as those at Chess Draw) is important.

In 1985, a surface study and later drilling took place in the area of Chess Draw, approximately 3 miles northwest of Wind Mountain, with REE as the exploration target (Sear, 1986). Chess Draw is a broad area of negative relief that was the site of a Holocene lake. Very little geological information can be discerned from the surface because of a lack of rock outcrop. In several places, resistant dikes are buried in the lake mud. Today they are exposed in arroyos caused by recent geomorphic rejuvenation. The drill holes reveal the startling geological relationships; beneath the geologically featureless topographic low there are extensive areas of intrusive rocks cut by multiple dikes and hydrothermal alteration.

REGIONAL GEOLOGY

The Cornudas region lies on the northern Diablo Plateau, underlain by a recognized Precambrian block that is overlain by thin veneers of Paleozoic and Mesozoic sedimentary rocks (Nutt and O'Neill, 1998). Perhaps as precursors to Tertiary rifting, the West Texas-New Mexico Tertiary alkaline igneous province developed, although others may attribute it to late Laramide subduction zone processes (see McLemore, this volume). The Cornudas intrusives, and most likely the Chess Draw igneous rocks, belong to this province. The Diablo Plateau has subsequently become an uplifted, internal block of the Rio Grande Rift that developed during the Tertiary. The plateau is bounded on the east by the Salt Graben and on the west by the Hu eco Bolson.

GEOLOGY OF THE CHESS DRAW AREA

The relatively flat lying Paleozoic sediments of the Diablo Plateau, equivalent to the Hueco, Yeso and San Andres Formations of Permian age, are at the surface near the Chess Draw area, and are upturned in numerous places surrounding the Chess Draw Depression (CDD) usually in association with intrusive masses nearby. Nutt and O'Neill noted Cretaceous sedimentary rocks near some of the topographically prominent intrusions and southeast of the study area. No Cretaceous rocks are found in Chess Draw. Dikes of alkaline and syenitic compositions are found on the margins of the depression, as are several small alkalic stocks.

Some of the Tertiary alkalic intrusives are prominent on the landscape due to their freshness and resistance (e.g. Wind and Cornudas Mountains, Fig. 1). In contrast to these positive features, several areas with negative topography are present, including Chess Draw area. The Chess Draw Depression (CDD), is an unusual, broad depression in the otherwise undulating dip slope of Paleozoic sediments of the Diablo Plateau. The CDD appears...
MINERAL EXPLORATION ACTIVITY AT CDD

Given the potential commodities to be discovered associated with these types of igneous rocks (e.g. REE and Zr), the area has been the target of some exploration efforts. The prominent, resistant intrusives are fresh, contain only rare occurrences of REE or Zr minerals and thus of little interest. Dikes, alteration, and brecciation are present in increasing abundance, respectively, in the minor intrusive outcrops in and around the CDD. Surface sampling also revealed enrichment in selected elements within the CDD. These initial results were enticing enough for U.S. Borax to engage in a drilling project in the area and drill core from three holes are currently in the possession of The University of Texas at El Paso. Drill hole C2 is located at the NW corner of section 17, T26S, R14E, Otero G., NM. C1 is 95 m 53° W from C2, and C3 is 760 m 55° E from C2. Drilling has revealed intrusive rock types such as trachytes, syenites, phonolites, and others (U.S. Borax, 1986), and these are significantly altered in places. Mineralized veins contain pyrite, fluorite, pyrochlore (Ca,Na),Nb,O,(OH,F)), zircon, bastnäsite ((Ce,La,Y)(CO3)2F) and quartz (R.A. Schriner, pers. comm., 1988).

Although drill hole control consists of only three points, Figure 2 illustrates a geologic cross section derived from drilling and summarizes the results. Large amounts of porphyritic syenite are present and the degree of brecciation, number of dikes, and the extent of hydrothermal alteration are significant (Scaar, 1986). In places, alteration is widespread, with much of the core exhibiting pervasive argillic alteration. Hole C-1 bottomed in a pyritized fault gouge.
Table 1. Ranges of selected chemical concentrations for lithologic samples from Chess Draw drill holes C1, C2, and C3. Also included are values from Cornudas Mountains (NM), and Sierra Blanca (TX) laccoliths and the Quitman Mountains (TX). Enrichment Factor: + means that some samples were > 2 times; ++ means > 10 times, no symbol means no apparent enrichment compared to average granite. All values in ppm except Ti in weight percent.

<table>
<thead>
<tr>
<th>Element</th>
<th>C-1 (275 m)</th>
<th>C-2 (245 m)</th>
<th>C-3 (245 m)</th>
<th>REE Vein Wind Mtn</th>
<th>Cornudas Mtns.</th>
<th>Wind Mtns. (3)</th>
<th>Quitman Mtns. (4)</th>
<th>Sierra Blanca, TX (5)</th>
<th>Ave. Granite (6)</th>
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<tr>
<td>Nb ++</td>
<td>10 - 430</td>
<td>16 - 320</td>
<td>6 - 190</td>
<td>10-1400</td>
<td>46-448</td>
<td>30-82</td>
<td>53 - 360</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Be</td>
<td>&lt; 2-14</td>
<td>2-6</td>
<td>&lt; 2-2</td>
<td>1.5 - 20</td>
<td>5</td>
<td></td>
<td></td>
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<tr>
<td>Ce +</td>
<td>&lt; 5 - 265</td>
<td>65-211</td>
<td>&lt; 5-225</td>
<td>1235</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eu +</td>
<td>&lt; 1 - 2</td>
<td>&lt; 1 - 3</td>
<td>&lt; 1 - 4</td>
<td>.18 - 1.5</td>
<td>1.2</td>
<td></td>
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<tr>
<td>Ho +</td>
<td>&lt; 1 - 2</td>
<td>&lt; 1 - 2</td>
<td>2.1 - 1230.0</td>
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<td></td>
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<tr>
<td>La +</td>
<td>24 - 198.0</td>
<td>31.6 - 126.0</td>
<td>&lt; 0.1 - 0.9</td>
<td>700</td>
<td></td>
<td></td>
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<td>Lu +</td>
<td>&lt; 1 - 0.9</td>
<td>0.3 - 0.7</td>
<td>&lt; 0.1 - 0.9</td>
<td>&lt; 1 - 3</td>
<td>1.5 - 8.5</td>
<td>.01</td>
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<td>Nd +</td>
<td>&lt; 0.5-67</td>
<td>26-73</td>
<td>&lt; 0.5 - 9.3</td>
<td>270</td>
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<td>Sc -</td>
<td>0.22</td>
<td>2.64 - 4.35</td>
<td>&lt; 0.5-14.9</td>
<td>9 - 5</td>
<td>5</td>
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<tr>
<td>Sm +</td>
<td>0.3 - 10.1</td>
<td>4.8 - 11.5</td>
<td>&lt; 0.5-14.9</td>
<td>13 - 15</td>
<td>3</td>
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<tr>
<td>Tb</td>
<td>&lt; 0.5 - 1.0</td>
<td>&lt; 0.6 - 1.5</td>
<td>&lt; 0.5 - 1.2</td>
<td>1.5 - 2.6</td>
<td>.05</td>
<td></td>
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<tr>
<td>Th +</td>
<td>&lt; 0.5 - 64.1</td>
<td>7.9-33.6</td>
<td>&lt; 0.5 - 20.8</td>
<td>8 - 77</td>
<td>1 - 47</td>
<td>34 - 205</td>
<td>17</td>
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<tr>
<td>Tm +</td>
<td>&lt; 0.5 - 0.8</td>
<td>&lt; 0.5 - 1.0</td>
<td>&lt; 0.3 - 1.1</td>
<td></td>
<td>0.5</td>
<td></td>
<td></td>
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<tr>
<td>Yb +</td>
<td>&lt; 0.5 - 0.8</td>
<td>2.1 - 5.9</td>
<td>&lt; 0.5 - 4.4</td>
<td>15 - 70</td>
<td>.06</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>U ++</td>
<td>&lt; 0.2 - 4.0</td>
<td>0.2 - 3.0</td>
<td>0.4 - 19.0</td>
<td>230 - 13000</td>
<td>7.3 - 35</td>
<td>4.8</td>
<td></td>
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<td>Ti +</td>
<td>0.01 - 0.42</td>
<td>0.21 - 0.40</td>
<td>.01 - .92</td>
<td>.08 - .26</td>
<td>.21 - .74</td>
<td>.01 - .6</td>
<td>.44</td>
<td></td>
<td></td>
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(1) McLemore et al. (1988)
(2) McLemore and Guilinger (1993)
(3) McLemore et al. (1996)
(4) Setter and Adams (1986)
(5) Shannon and Goodell (1986)
(6) Levinson (1980)

values represent maximum concentrations, and not large volumes of average concentration, should be noted by the reader. In the slightly enriched elements (Fig. 3A), the CDD samples are very similar to those associated with the beryllium deposit at Sierra Blanca, Texas. Significant differences are seen as the CDD is slightly enriched with respect to Zr but depleted with respect to U when compared with Sierra Blanca. In the moderately enriched elements (Fig. 3B), the two areas show marked similarity, although Sierra Blanca is significantly enriched in Tb and is depleted in La compared to drill hole C-3 at the CDD. In the highly enriched elements, Lu and Yb, Sierra Blanca is significantly more enriched compared to the drill holes in the CDD. Both rocks are highly enriched in F (not plotted) in both areas displaying enrichment factors of approximately 28,000 over average granite.
DISCUSSION AND CONCLUSIONS

The area of interest consists of negative topography surrounded by upturned beds cut by altered igneous dikes. Pervasive alteration, dikes, and brecciation are present in portions of the drill holes. The area of negative topography is much larger than the area drilled. A sufficient portion of the Chess Draw geomorphic depression was not drilled to effectively evaluate the economic potential of the area. It is likely that altered igneous rock such as encountered in the drill holes underlies the entire CDD. Nutt and O’Neill (1998) noted the presence of a large intrusive body in the area of Chess Draw based on magnetic data. We propose that the area of the Chess Draw depression was a volcanic vent or subvolcanic intrusion. This vent was subsequently altered by hydrothermal solutions that produced the geochemical anomalies observed. Erosion of the altered igneous rock produces the negative topographic expression.

The intent of this manuscript is to convey the fact that there has been much more hydrothermal and magmatic activity in the Cornudas area than can be seen, or has been reported in the literature. Prior studies of igneous rocks in the Cornudas are of topographic landmarks; prior studies of topographically negative areas have not been reported. Further work aims to test the presence of an igneous center at Chess Draw which has been so altered that it forms a topographic depression and to evaluate the geochemical potential of the area. The high fluorine content and vein mineralogy described in this paper are similar to the Red Cloud breccia-fluorite deposits of Lincoln County, New Mexico (Williams-Jones et al., 2000). Future exploration programs should be modeled accordingly.

ACKNOWLEDGMENTS

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REFERENCES


Mutschler, F.E., Mooney, T.C., and Johnson, D.C., 1991, Precious metal deposits related to alkaline igneous rocks - A space-time trip through the Cordillera:


Names and ages based on IUGS data. The El Paso Fm. can alternatively be divided into units from Flower (1964), in ascending order Sierrite, Big Hatchet, Cooks, Victorio Hills, Jose, Mud Springs Mountain, Snake Hills, McKelligon, Scenic Drive, and Florida Mountains.