Introduction

Rare earth elements (REE) are used in the electronics, automotive and metallurgical industries. Deposits containing REE are found throughout New Mexico (Fig. 1). Approximately 64 metric tons of bastnaesite was produced in the 1950s from the Gallinas district, Gallinas Mountains, Lincoln County. Since then, several companies and the U.S. Bureau of Mines (Schreiner, 1993) have conducted various exploration programs to identify and delineate REE resource potential. Four types of deposits are found in the district: epithermal REE-F veins, Cu-REE-F veins, REE-F breccias and iron skarn deposits; all are associated with Tertiary alkaline to alkalic-calcic igneous intrusions. A fifth type of deposit, carbonatite deposits, could be in the subsurface as suggested by previous drilling, but no samples have been obtained for precise determination of the lithology.

A number of previous reports have examined the geology and mineral resources of the Gallinas Mountains, but few examined the resource potential for REE and re-examination of these previous studies is warranted in light of today’s potential economic importance of REE. Therefore, the purposes of this report are 1) to compile and interpret available published and unpublished data from the Gallinas district and 2) to summarize the geology, geochemistry, resource potential and origin of the mineral deposits in the Gallinas district and relate the mineral deposits to other REE deposits in New Mexico and elsewhere.

Geology

The Gallinas district is found in central New Mexico (Fig. 1) and is part of the Lincoln County porphyry belt. Lithologies found in the district include: Proterozoic granite and gneiss; Permian sedimentary units of the Abo, Yeso, and Glorieta Formations; and Tertiary trachyte/phonolite, rhyolite, andesite, latite and magmatic-hydrothermal breccias. The igneous rocks in the Gallinas Mountains are metaluminous to peraluminous, alkaline volcanic rocks, and
have chemical compositions similar to A-type granitoids (McLemore, 2010). A-type (anorogenic or anhydrous) granitoids typically are found along rift zones and within stable continental blocks.

The mineralogy in the district is diverse and includes fluorite, quartz, barite, pyrite, iron oxides and accessory bastnaesite, parasite, calcite, chalcedony, galena, bornite, chalcocite, pyromorphite, anglesite, chrysocolla, malachite, and azurite and rare agardite (yttrium-arsenic oxide), mimetite, wulfenite, vanadinite, mottramite, cerusite, among others. Geothermometric fluid-inclusion studies indicate a temperature of formation of 250-400°C with salinities of approximately 15 NaCl eq. wt.% at pressures of 1-2 kbar (William-Jones et al., 2000). Alteration includes brecciation, silicification, chloritization, and fenitization (Schreiner, 1993).

Geochemical anomaly maps were constructed using ARCMAP and indicate that the higher concentrations of REE, Cu, Pb, and Au are found along faults filled with Cu-REE-F and REE-F veins and the M and E breccia deposit (McLemore, 2010). District zonation for the Gallinas Mountains was determined by mineralogy and chemistry of the individual deposits. Base metals veins (Cu-REE-F) form the center of the district, surrounded by REE-F veins (Fig. 2). The magmatic-hydrothermal breccia deposits form a belt partially surrounding the veins. Iron skarns formed at the top and edge of the trachyte intrusion and are likely the earliest stage of mineralization. The iron skarns are probably related to the REE-F veins and breccias because they typically contain bastnaesite and fluorite.

In 1991-1992, USBM calculated an inferred resource of 0.487 million metric tons with a grade of 2.95% total REE (Schreiner, 1993). The REE deposits in the Gallinas district are among the highest potential in New Mexico. They are similar in size and grade to small- to medium size deposits found elsewhere in the world (Fig. 3). Chemically, samples from the Gallinas district are similar in REE chemistry to Bayan Obo, Lemhi Pass, and Olympic Dam deposits (McLemore, 2010). With the projected increase in demand of REE, domestically and globally, areas such as the Gallinas district in New Mexico are being re-examined for additional REE potential.

References

Fig. 1. Mining districts in New Mexico that contain REE deposits (modified from McLemore et al., 2005). These mineral deposits in New Mexico have been referred to as Great Plains Margin (GPM) deposits by North and McLemore (1986, 1988) and McLemore (1996).
Fig. 2. Mineral zoning in the Gallinas Mountains, Lincoln County, New Mexico, based upon predominant mineralogy and chemistry of the known deposits (Schreiner, 1993; McLemore, 2010).
Fig. 3. Grade and size (tonnage) of selected REE deposits, using data from Oris and Grauch (2002) and resources data for the Gallinas Mountains from Schreiner (1993) and Jackson and Christiansen (1993). Deposits in bold are located in New Mexico.