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Carbonatites in the Wet Mountains Area, Custer and Fremont Counties, Colorado--Chemical and Mineralogical Data

By

T. J. Armbrustmacher and I. K. Brownfield

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Introduction

The purpose of this report is to present chemical analytical and mineralogical data for 90 samples of carbonatite collected as part of a U.S. Geological Survey program to assess the resource potential of the Wet Mountains, Colorado thorium province (Armbrustmacher, 1976). The carbonatites fall into two distinct groups, replacement and primary, both of which belong to the Cambrian alkalic igneous event that also includes the McClure Mountain and Gem Park Complexes (Parker and Sharp, 1970; Shawe and Parker, 1967), the complex at Democrat Creek, and the quartz-barite-thorite veins of the Wet Mountains thorium province (Christman and others, 1959). In replacement carbonatites pseudomorphs of carbonate minerals after an originally porphyritic or hypidiomorphic-granular rock, probably lamprophyre or "red-rock" syenite, can be seen in thin section. Primary carbonatites lack similar replacement textures. Other differences also occur, especially in the average composition of certain elements and in the mineralogy.

Sample Preparation

Composite samples about 1 kg were typically collected from the carbonatite localities shown on figure 1. An additional hand specimen for thin section preparation was also usually collected. The composite samples were ground to -20 mesh and split until an aliquot of approximately 150 g was attained. This aliquot was further ground to -100 mesh and submitted to the analytical laboratories for 6-step semiquantitative spectrographic analysis. The remaining ground sample, at least 600 g, was analyzed for radium equivalent uranium (RaeU), thorium (Th), and potassium (K) using gamma-ray spectrometric techniques. After the nondestructive gamma-ray spectrometric analysis, the same sample was passed through methylene iodide and the fraction that was heavy enough to sink was split into 2 to 5 additional fractions by standard magnetic separation. Mineral components in each fraction were then identified either by X-ray powder diffraction techniques or by sight. Typical X-ray diffractometer settings for Cu/Ni radiation are, $\gamma CuK\alpha$=1.5418Å, scan speed 2° 2θ per minute, chart speed 1/2 in per minute, slits 1° front, 0.01 in receiving, 32 kv, 18 mamps, range 300 cps, and T. C. 3 sec. Measurements of alpha radiation were also made of each mineral separate before X-ray. Rock textures were described and additional mineral identifications were made petrographically.

Chemical Analytical Data

Results of the 6-step semiquantitative spectrographic analyses and gamma-ray spectrometric analyses of individual primary and replacement carbonatite samples are given in tables 1 and 2, respectively. The spectrographic analyses report concentrations in six geometric steps having midpoints at 1.5, 2, 3, 5, 7, 10, 15, and so on. The precision of a given value is about plus or minus one step at 68 percent confidence. The field number (fig. 1), the laboratory number, and the name of the claim or locally used name are included in tables 1 and 2 for identification purposes. Some of the names may be outdated due to claim staking subsequent to our visit.

The gamma-ray spectrometric analyses are significant to three digits. Precision of RaeU and Th analyses is 0.05 ppm plus 2 percent of the stated value; precision of K analyses is 0.03 percent plus 1 percent of the stated value.

Histograms of the concentrations of each element, exluding RaeU, Th, and K, are shown on figure 2. The arithmetic mean of each set of values is included even though it may not be significant due to the lack of a log-normal distribution. For comparison of element content in replacement and primary carbonatites, median values are indicated by arrows. The median is not greatly influenced by a few unusually high or low values and may represent a more accurate measure of central tendency than the arithmetic mean. For calculating arithmetic mean, values reported as "greater than" the upper detection limit were assigned a value one step above the

highest detectible value. Values reported as not detected (N) or below limit of determination (L) were assigned a value two steps below the lowest detectible value. In some instances, due to interferences, the lower detection limit is higher than usual. These were assigned values two steps below the value given in parentheses.

Mineralogy

Composite lists of minerals identified in primary and replacement carbonatites are also given in tables 1 and 2, respectively. Additional minerals could almost certainly be found at similar sample localities and probably even in the same samples. This is especially true of minerals that occur in sparse amounts. Some samples, because of grain size, alteration, or other factors, do not lend themselves to the mineral-separation techniques used in this study, and the list of minerals in tables 1 and 2 is thus not complete.

The mineralogy of certain carbonatites in the Wet Mountains has also been reported for Road Gulch (Staatz and Conklin, 1967), the Gem Park area (Parker and Sharp, 1970), the Goldie carbonatite (Heinrich, 1977), a colloform carbonatite (Heinrich and Salotti, 1975), and the Amethyst carbonatite (Heinrich and Shappirio, 1966). Some of the same localities were revisited during this study and the results confirmed.

References Cited

Armbrustmacher, T. J., 1976, Thorium deposits in the Wet Mountains area, Fremont and Custer Counties, Colorado: U.S. Geol. Survey Open-File Rept. 76-284, 18 p.

Christman, R. A., Brock, M. R., Pearson, R. C., and Singewald, Q. D., 1959, Geology and thorium deposits of the Wet Mountains, Colorado; a progress report: U.S. Geol. Survey Bull. 1072-H, p. 491-535.

Heinrich, E. W., 1977, Aluminofluoride minerals of the Goldie carbonatite, Fremont County, Colorado: Mtn. Geologist, v. 14, p. 33-46.

Heinrich, E. W., and Salotti, C. A., 1975, A colloform carbonatite, McCoy Gulch, Fremont County, Colorado: Mtn. Geologist, v. 12, p. 103 111.

Heinrich, E. W., and Shappirio, J. R., 1966, Alkalic rocks and carbonatites of the Arkansas River Canyon; 3--The Amethyst carbonatites: Am. Mineralogist, v. 51, p. 1088-1106.

Parker, R. L., and Sharp, W. N., 1970, Mafic-ultramafic igneous rocks and associated carbonatites of the Gem Park Complex, Custer and Fremont Counties, Colorado: U.S. Geol. Survey Prof. Paper 649, 24 p.

Scott, G. R., Taylor, R. B., Epis, R. C., and Wobus, R. A., 1976, Geologic map of the Pueblo $1^{o}x2^{o}$ quadrangle, south-central Colorado: U.S. Geol. Survey Misc. Field Studies Map MF-775.

Shawe, D. R., and Parker, R. L., 1967, Mafic-ultramafic layered intrusion at Iron Mountain, Fremont County, Colorado: U.S. Geol. Survey Bull. 1251-A, 28 p.

Staatz, M. H., and Conklin, N. M., 1967, Rare-earth thorium carbonate veins of the Road Gulch area, northern Wet Mountains, Colorado, in Geological Survey Research 1966: U.S. Geol. Survey Prof. Paper 550-B, p. B130-B134.

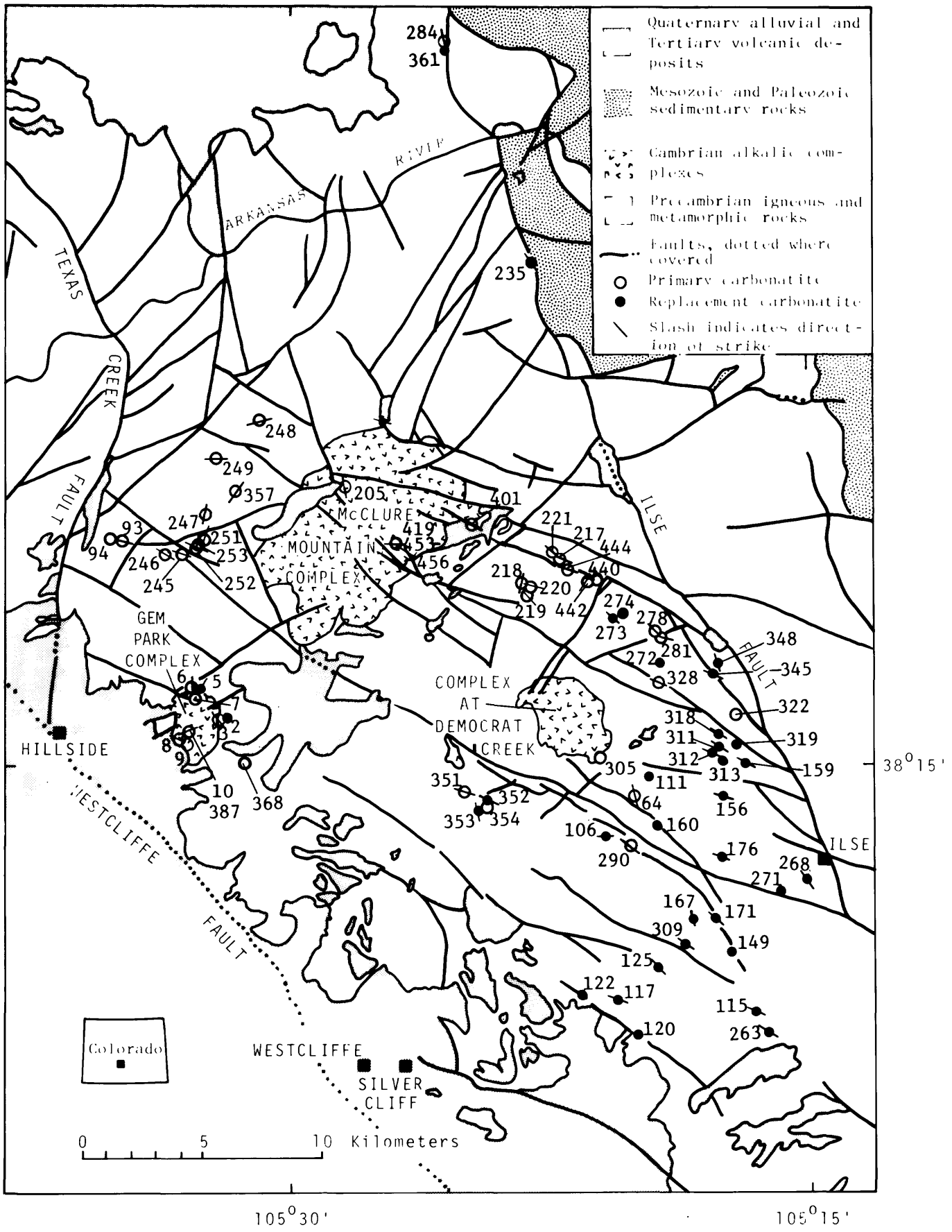

Figure 1.--Sample localities for carbonatites, Wet Mountains, area, Colorado. Modified from Scott and others, 1976.