A FLUORITE-BEARING GRANITE
Belmont Mountains, Central Arizona

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Recent geologic mapping of the Belmont and Bighorn Mountains in central Arizona (Figure 1) has resulted in the recognition of a granite that locally contains fluorite, a calcium-fluoride mineral (CaF_2) that is rare in granitic rocks in the State. The existence of this fluorite-bearing granite has not, to our knowledge, been previously described in the published literature. The presence of this granite has implications for the geologic history and mineral potential of the Belmont Mountains and surrounding area.

Geologists from the Arizona Bureau of Geology and Mineral Technology are revising the present geologic map of Arizona that was published in 1969, but was largely based on reconnaissance mapping done before 1960. As part of the Geologic Map Revision Project, the Bureau entered into a cooperative geologic mapping agreement (COGEOMAP) with the U.S. Geological Survey (USGS).* Funding of COGEOMAP activities is evenly shared by the Bureau and USGS. Under the auspices of COGEOMAP, Bureau geologists mapped the Bighorn and Belmont Mountains earlier this year. The geology of neither range had previously been mapped, except in a reconnaissance manner (Wilson and others, 1957). Geologic mapping for the present project was done on 1:24,000- and 1:50,000-scale topographic base maps and 1:24,000-scale color aerial photographs that the U.S. Bureau of Land Management contributed. The mapping, presently being compiled, will be published at scales of 1:24,000 and 1:50,000 and will be accompanied by detailed discussions of the geology and mineral deposits of both ranges.

The geology of the Belmont Mountains is shown on the present geologic map of Arizona (Wilson and others, 1969) as being composed of Precambrian granite with lesser amounts of Pre-

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* See *Fieldnotes*, vol. 15, no. 1, p. 4–5.

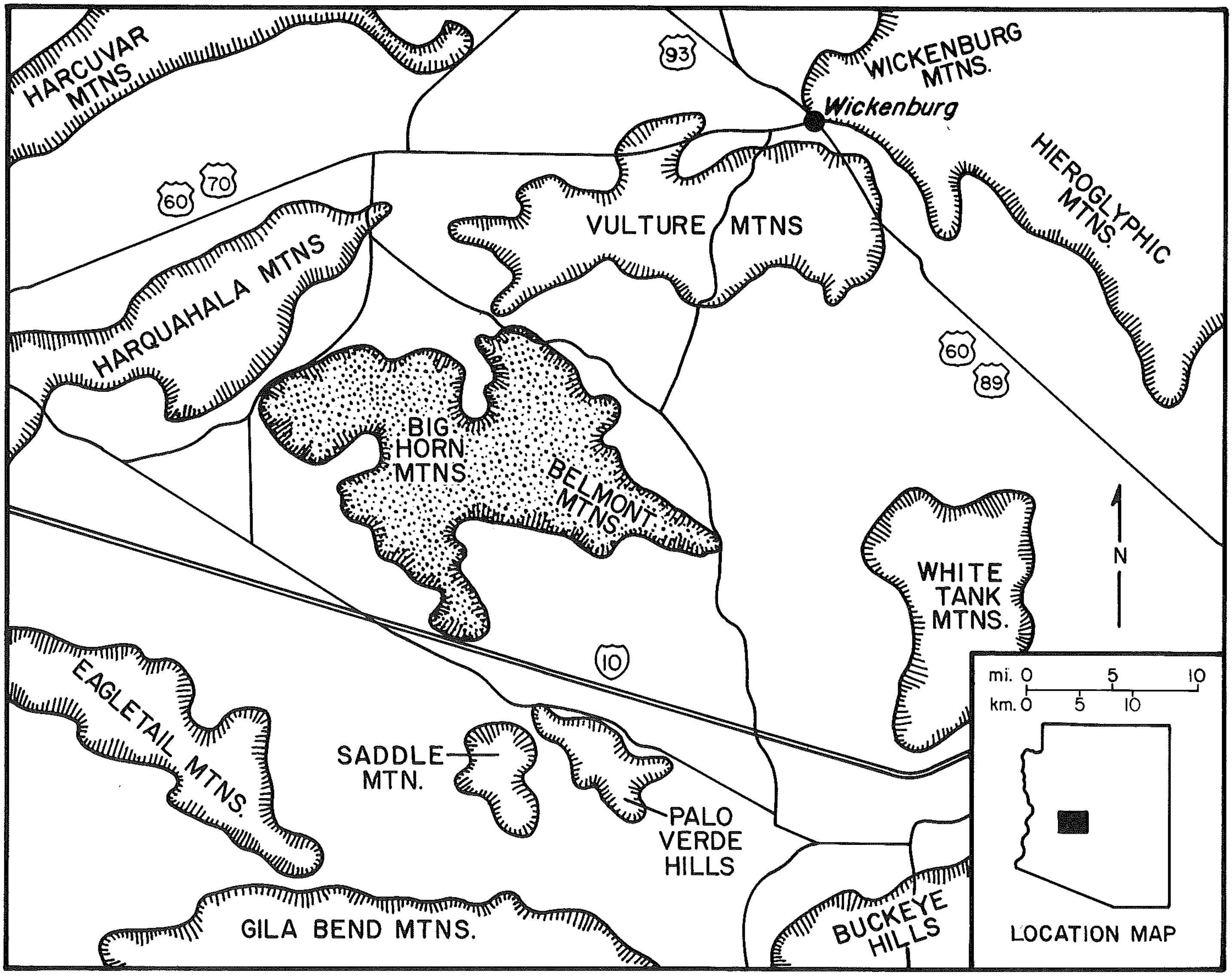

Figure 1. *Map showing the location of the Belmont and Bighorn Mountains.*

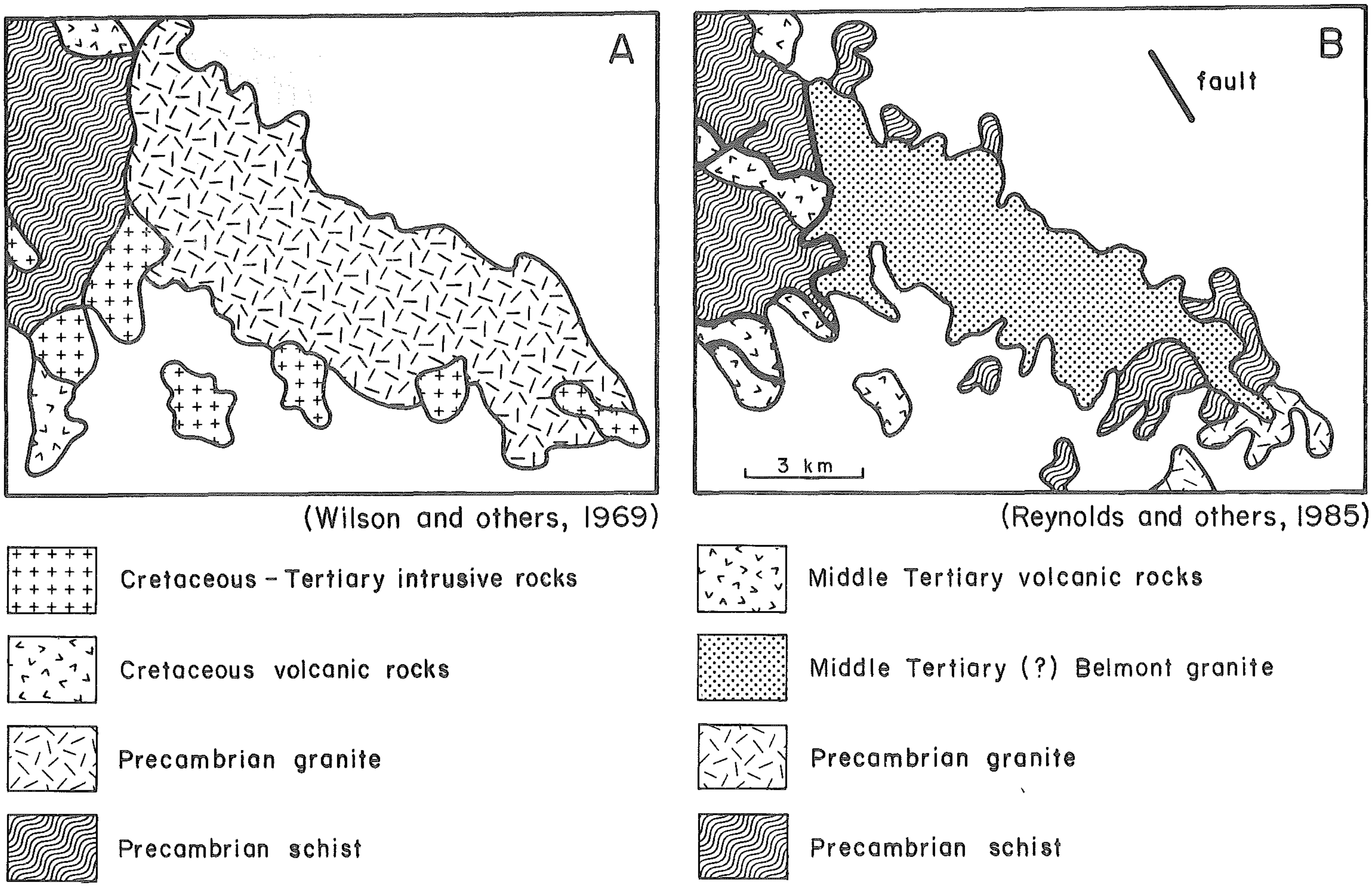

Figure 2. Geologic maps of the Belmont Mountains. Maps illustrate the evolution in understanding the area's geology from Wilson and others (1969) to Reynolds and others (1985; this study).

Figure 3. Photograph of miarolitic cavity in the Belmont Granite.

cambrian schist and Cretaceous volcanics and intrusions (Figure 2a). As a result of our more detailed mapping (Figure 2b), we have reinterpreted the "Cretaceous" volcanic and intrusive rocks as being middle Tertiary in age. In addition, most of the area shown on previous maps as Precambrian granite is composed of the fluorite-bearing granite, which we interpret as middle Tertiary, rather than Precambrian in age.

The fluorite-bearing granite occurs as a large mass that forms most of the high crest of the Belmont Mountains (Figure 2b). It is a very light-colored rock because of a pronounced lack of dark minerals, except for a small amount of biotite and magnetite. The granite varies in texture from a typical, medium-grained granite to a very fine-grained granite with scattered, larger crystals of quartz. Unlike most granites in Arizona, it contains miarolitic cavities (Figure 3), which are small, crystal-lined voids that represent pockets of water-rich fluid and vapor that formed late in the crystallization history of the granitic magma. The presence of such cavities indicates that the granite crystallized from a magma at a very shallow depth, probably within several kilometers of the surface. The miarolitic cavities are lined with well-formed crystals of quartz and feldspar (Figure 3), and lesser amounts of muscovite, biotite, purple fluorite, epidote, and other minerals.

Granites that contain fluorite are apparently rare in Arizona. No fluorite-bearing granite is identified in the book *Mineralogy of Arizona* (Anthony and others, 1977), although fluorite is described in some pegmatites. Fluorite is present in the Dells Granite near Prescott and the Lawler Peak Granite near Bagdad (Silver and others, 1980). In addition to containing fluorite, both of these granites are anomalously rich in rubidium, uranium, thorium, and other lithophile elements (elements that are concen-

Table 1. Chemical composition of Belmont granite and selected granites. Data are from Silver and others (1980;Dells), Creasey (1984;Schultze), Nockolds (1954; Average Granite oxides), Turekian and Wedepohl (1961; Average Granite trace elements), and S. J. Reynolds (unpublished data; Belmont and South Mountains).

	Belmont	Average Granite	Dells	Schultze	South Mountains
MAJOR OXIDES (Weight Percentages)					
SiO_2	74.7	72.1	75.6	70.89	73.8
TiO_2	0.12	0.37	0.03	0.25	0.15
Al_2O_3	12.0	13.9	13.1	16.1	13.9
FeO	0.39	1.67	0.32	0.46	—
Fe_2O_3	0.96	0.86	0.46	1.12	1.36
MnO	0.05	0.06	0.03	0.03	0.05
MgO	0.05	0.52	0.05	0.55	0.35
CaO	0.46	1.33	0.62	2.01	1.19
Na_2O	4.06	3.08	4.14	4.67	4.31
K_2O	5.05	5.46	4.53	3.58	4.13
P_2O_5	0.05	0.18	<0.01	0.12	0.11
H_2O	0.25*	0.53	0.52	0.35	0.15*
TRACE ELEMENTS (parts per million)					
Ba	<15	420	25	1010	—
F	630	520	—	—	—
Li	16	24	—	—	—
Mo	2	1	—	—	—
Nb	42	20	77	—	21
Rb	259	110	294	106	95
Sn	4	1.5	—	—	—
Sr	23	440	11	635	262
W	4	1.3	—	—	—
Y	27	35	111	—	9
Zr	109	140	107	120	73

* Loss on ignition

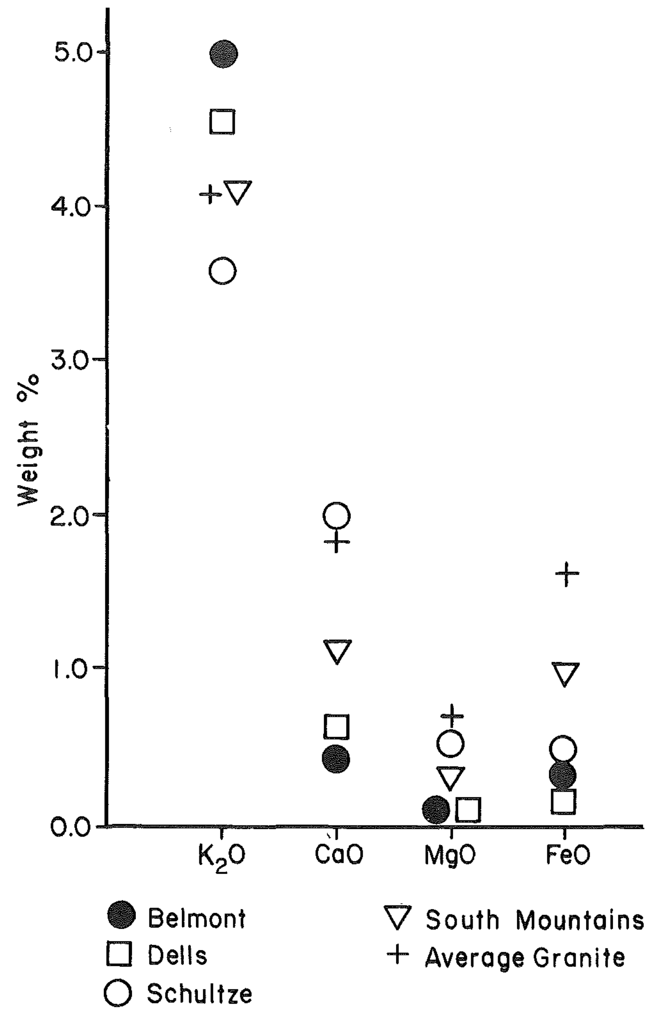

Figure 4. Plot comparing compositions of the major-element oxides of the Belmont Granite with those of other granites. See Table 1 for data and references.

trated in the Earth's silicate crust). Recognizing that the presence of fluorite in a granite could indicate a high potential for mineralization of elements such as molybdenum, beryllium, and tin, we have analyzed the chemical composition of one phase of the Belmont granite (Table 1). The chemical analyses confirm that the granite is very different in overall chemical composition from most other granites in Arizona, except the Dells Granite (Figure 4). The Belmont granite contains much less magnesium, iron, and calcium than most other granites in Arizona, but is slightly enriched in elements, such as rubidium and niobium, that are abundant in granites associated with molybdenum and tin mineralization.

Although the Belmont granite itself is generally fresh and unaffected by significant mineralization, some important occurrences of precious- and base-metal mineralization in the Belmont and Bighorn Mountains are accompanied by fluorite, as well as quartz, calcite, and barite. Much of this mineralization is related to middle Tertiary volcanism and faulting (George Allen, 1985, personal communication). If the Belmont granite is middle Tertiary, as we presently interpret based on field relationships, then the granite may represent a magma chamber that was a source of middle Tertiary volcanics and mineralizing fluids.

It is important to note that the Belmont granite has probably been tilted about 40° to the northeast by middle Tertiary faulting. If this interpretation is correct, the Belmont Mountains contain an exposure of a large, middle Tertiary, fluorite-rich, granitic magma chamber that is lying on its side.

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