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Title of article Preliminary petrographic, chemical, and age data on some  
intrusive and associated contact metamorphic rocks, Pioneer Mtns.,  
southwestern Montana

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see GSA Bulletin v. 86, p. 367 - 370

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## Appendix: Sample Description

Quartz diorite, 313-1 (DR). Dark-gray medium-grained (average grain size about 1 mm) equigranular rock. Interlocking laths of plagioclase ( $An_{35-70}$ , mean = 60) are twinned, strongly and complexly zoned, and euhedral; brown biotite and green hornblende are euhedral to subhedral; anhedral quartz fills interstices. Potassium feldspar is not revealed by cobaltinitrite test. Euhedral sphene is abundant. Alteration of rock in outcrops is mainly by development of epidote along joint surfaces; analyzed rocks are free of such secondary mineralization.

Porphyritic granodiorite, 9850-ft altitude, Barbour Hill north slope (BH 9850). Light-gray, medium-grained rock. Mafic minerals and larger white plagioclase phenocrysts give rock a salt-and-pepper appearance and uneven texture in hand specimen. Faint foliation defined by orientation of mafic minerals is visible. Zoned twinned euhedral and subhedral phenocrysts of white plagioclase ( $An_{35}$ ), as large as 2 cm, are not uncommon and are set in a groundmass of finer (1-mm-long) plagioclase laths. Large anhedral quartz is in rounded grains; large anhedral potassium feldspar is interstitial, enclosing finer grained plagioclase, and is revealed by staining. Biotite (brown) is partly altered to chlorite. Hornblende is euhedral and shows characteristic pleochroic colors. Sphene and opaque minerals are major accessories.

Granite, summit of Barbour Hill (BHS). Very light gray coarse-grained rock (average grain size 5 mm). A subtle foliation is expressed by alignment of biotite books and of long dimensions of plagioclase crystals; a false foliation visible in many outcrops is caused by a set of planar fractures that cut feldspar crystals into apparently smaller crystals. Plagioclase ( $An_{28}$ ) is twinned and weakly zoned, euhedral to subhedral; some crystals, particularly their cores, are saussuritized to aggregates of clinozoisite and white mica. Potassium feldspar is anhedral and fills the interstices, and it commonly encloses the plagioclase. Quartz occurs in aggregates of finer grained anhedral. Wormy intergrowth of feldspar and quartz(?) is commonly observed, especially along contacts between plagioclase and potassium feldspar. Brown biotite is partly altered to chlorite; hornblende is not found. In hand specimen, the rock is very similar to the Butte Quartz Monzonite of the Boulder batholith (Tilling, 1973) but is more sodic and siliceous and less potassic, as discussed in the main text (see Fig. 3). The IUGS system of rock classification would designate it a granite because it has more than 20 percent by volume of quartz.

Tonalite, Ivanhoe Pit roadcut (IVP). Sample collected at new (ca. 1970) roadcut on access road to Ivanhoe Pit just west of Brown's Lake on south side of road, west end of pit. Equigranular light-gray rock, average grain size about 3 mm. A faint foliation defined by alignment of biotite books is visible. Plagioclase is euhedral to subhedral, twinned

and zoned ( $An_{40}$ ); anhedral potassium feldspar is rare and encloses the plagioclase. Wormy intergrowth occurs at the contacts of the two feldspars. Quartz is anhedral. Brown biotite is somewhat altered to chlorite; hornblende is euhedral. Sphene and opaque minerals are major accessories.

Porphyritic granodiorite, Birch Creek roadcut (BC). Sample collected at new (ca. 1970) roadcut opposite Forest Service Birch Creek Ranger station (BM6420 ft; see Myers, 1952). Twin Adams quadrangle. Medium-gray, fine- to medium-grained rock having phenocrysts of white plagioclase feldspar and rarer quartz as much as 1 cm across. Rock has a salt-and-pepper appearance in hand specimen and very faint foliation caused by alignment of biotite. Groundmass grains, about 0.3 mm, consist partly of anhedral and interstitial quartz and potassium feldspar, but are mainly euhedral zoned and twinned plagioclase ( $An_{35}$ ). Despite their similar hand-specimen appearance and mode, the small distinct grains of potassium feldspar, not enclosing other minerals, sets sample BC apart from BH 9850, with its large anhedral potassium feldspar enclosing plagioclase. Biotite is partly altered to chlorite. Orthite, sphene, and opaque minerals are major accessories.

Biotite gneiss, Hecla basin, 287-1 and 287-2. Two similar samples of the lower Paleozoic (Middle Cambrian) Silver Hill Formation (mapped as the correlative Wolsey Shale by Karlstrom, 1948) metamorphosed by contact with the intrusive rocks into biotite-porphyroblast gneisses. Rocks have fine, dark-gray matrix in which black biotite porphyroblasts, in spherical clusters about 5 mm across, are set. The matrix consists of andalusite, biotite, muscovite, quartz, plagioclase, and tourmaline as major minerals. Average grain size is 0.1 to 0.2 mm. Plagioclase is round, zoned parallel to crystal outline, and shows little or no twinning. Quartz is polygonal. Andalusite is fresh; the core areas tend to be poikilitic. Biotite is brown and free from chloritic alteration.