solubility of gold owing to a change in pH (Henley, 1984). Gold solubility relations at 250 °C, a temperature considered by many to approximate thermal conditions in most Au-bearing skarns during paragenetic stage(s) of gold deposition, culminate at oxygen activity-pH conditions compatible with pyrite stability (Romberger, 1988). As Romberger (1988) further noted, if most gold is transported as a bisulfide complex, gold deposition may be accomplished by any chemical reaction or physicochemical process that decreases chemical activity of sulfur components dissolved in aqueous fluids circulating through skarn, including deposition of sulfide minerals and loss of sulfur components because of boiling.

Geophysical Signatures

Well-developed, local magnetic highs result from increased abundance of pyrrhotite and (or) magnetite in some Au-skarn systems (see Wotruba and others, 1987a, b). However, other Au-skarn systems are associated mostly with pyrite in their unoxidized parts (McCoy) and show no distinctive magnetic signatures (Bruce A. Kuyper, oral commun., 1987).

Ore Controls/Exploration Guides

In established mining districts zoned from mostly proximal copper-dominant deposits to distal precious-metal-dominant and base-metal-dominant veins, all stratigraphic sequences favorable for development of skarn in the zone of precious-metal deposits should be considered as permissive hosts for development of Au-bearing skarn. Polymetallic veins and polymetallic replacement deposits showing geochemical signatures and sulfide mineral assemblages similar to those at many Au-bearing skarns (for example, the Fe-As-Zn-Cu-Bi-Au- and Sb-bearing ores at the Matsuo Mine, Japan; Matsukuma, 1962) may be high-level or lateral reflections of Au-bearing skarn. Other guides include: reported gold in base- and ferrous-metal skarn systems; gold placers in regions permissive for the formation of skarn (R.G. Russell, written commun., 1989), especially if the placer gold is intergrown with bismuth minerals, including bismuth oxides or bismuth tellurides (Theodore and others, 1987; Theodore and others, 1989). Anomalous values of bismuth, tellurium, arsenic, selenium, and cobalt are useful geochemical signatures for some gold-bearing skarns (tables 2, 3; Brooks and Meinert, 1989).

Metal ratios in jasperoids, which commonly occur in or on the fringes of gold skarn systems, may also provide useful geochemical signatures for exploration. Faults cutting skarns and intersecting structures are important pathways along which retrograde assemblages and associated ores are concentrated. R.G. Russell (written commun., 1989) distinguishes between barren, early, high-temperature contact skarn formed adjacent to intrusive rocks and mineralized, fracture-enhanced exoskarn developed in Au-skarn systems.

Although pyroxene (hedenbergite)- and pyrrhotite-rich distal skarns host gold mineralization in some deposits, such as the Fortitude, garnet-pyroxene (diopsidic) and chalcopyrite or pyrite-rich proximal skarns are the locus of gold mineralization at other deposits, such as McCoy. Further studies on Au-bearing skarn deposits may reveal relatively reduced (Fortitude) and oxidized (McCoy) types of gold-bearing skarn, such as have been recognized for tungsten skarns (Einaudi and others, 1981).

GRADES AND TONNAGES OF GOLD–BEARING SKARNS

Graphs of grades and tonnages of 40 Au-skarns from table 2 and 50 byproduct Au-skarns from table 3 are shown in figures 1, 2, and 13. Gold grade must be 1 g/t or higher to be included, as described above. Median tonnage for the Au-skarn subtype is about 213,000 tonnes (fig. 1*C*), and median tonnage for the byproduct Au-skarn subtype is about 330,000 tonnes (fig. 1*D*). For the Au-skarn subtype there is a strong negative correlation between gold grade and tonnage (linear correlation coefficient = -0.69); this relation is slightly weaker for the byproduct Au-skarn subtype (linear correlation coefficient = -0.54). The Au-skarn subtype has a median gold grade of about 8.6 g/t and a median silver grade of about 5.0 g/t (figs. 2*C* and 13*A*). The determination of median silver grade for the Au-skarn subtype is based upon values of silver grade available for 29 of 40 deposits (table 2). Meinert (1988a) tabulated Au, Ag and Cu grades for various types of skarns. The fourteen deposits he classified as gold skarns all have gold grades greater than 1 g/t Au and largely overlap our data set. Median gold grade for Meinert's gold skarn set is 6.5 g/t; median silver grade for the nine deposits that report silver is 9 g/t. For the byproduct Au-skarn subtype, the medians are 3.7 g/t gold and approximately 34 g/t silver. Nearly 90 percent of the byproduct Au-skarns report silver (table 3). Silver content appears to have a strong correlation with base-metal content. As a comparison, the median gold grade for 14 porphyry copper-related Cu skarns, as reported by Meinert (1988a), is approximately 0.3 g/t and the median silver grade is approximately 8 g/t (note that these values are higher than those reported by Singer, 1986) for gold in porphyry copper-related skarns.

We found wide variations in gold grade distributions. In fact, values of gold grade reported during various stages of exploration and development of many deposits typically show significant adjustments, usually in a descendent manner. Furthermore, tests of the gold grade distribution for Au-skarns indicate that the addition of approximately 40 deposits with grades less than 3.7 g/t would be required