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Evolution of the mineral composition of gold deposits as result of crust-mantle contribution in Earth history

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According to modern data (De Ronde et al., 1992, Goldfarb et al., 2001, 2005, 2010, 2015, Groves et al., 2005), commercial gold deposits are distributed discretely over time: 3.3-3.1; 2.8-2.5; 2.1-1.8; 0.8-0.55; 0.45-0.40; 0.33-0.25, 0.18-0.12, and 0.10-0.0 billion years. These gold mineralization periods correlate with the main orogenic events in the supercontinental cycles. The bulk of gold was formed during the Archean and Early Proterozoic times, when Au clearly demonstrated its mantle origin in orogenic metallogeny (association with Ni, Cu, Pt, Fe deposits). In Meso- and Neoproterozoic, an association of gold deposits with uranium deposits and black shales is added to them, and in the Phanerozoic is added of Mo, Cu, W, Ag, Sb, Hg and even Sn deposits (Pacific Rim, Central Asia orogenic belt). This corresponds to the overall growth of the Earth's crust (Condie, Aster, 2010) and demonstrates the increase in time of the share of the crustal contribution to the metallogeny of gold. The metallogeny of gold in the Neoproterozoic and later demonstrates the duality caused by the separation of the gold deposit areas of the tectonic zones as mafic (island arc, accretion) and sialic (accretion, collision) profiles. The association of orogenic gold deposits with VMS or Cu-Ni deposits is retained only for femic metallogenic provinces (Ural, etc.), which emphasizes the important role of the mantle in the gold metallogeny. Gold mineralization in sialic folded belts on deformed passive continent margins is often associated with black shales. Gold deposits in the sialic belts are divided into the orogenic and intrusion-related from this time. Epithermal Au-Ag mineralization is added to these two types, since the Middle Paleozoic, and most abundant in the Late Mesozoic - Cenozoic. This evolution is the result of differentiation of the mineral composition of orogenic gold deposits in time. For example, tourmaline is a common mineral in the Archean and Early Proterozoic orogenic gold deposits, together with the minerals of the Au-accompanying triad (As, Sb, Bi) and sulfur analogs (Te, Se). But, in the Phanerozoic gold deposits tourmaline is atypical for orogenic and is common only in intrusion-related deposits. And, the mineralization accompanying gold in the Phanerozoic gold deposits (especially for the Late Mesozoic and Cenozoic) is clearly divided into As-Sb-Ag-Se mineralization (usualy arsenopyrite, sulphosalts, stibnite etc., and Pb tellurides for mafic belts only) in orogenic and epithermal ores and As-Bi-Te mineralization (lollingite, arsenopyrite, Bi-sulphosalts, Bi-tellurides and Bi-sulphotellurides) in intrusion-related ores associated with granitoids of subduction and collision settings. This is most typical for the Northern Pacific Rim. The contribution of the crustal component to the Phanerozoic Au metallogeny is recorded clearly in the isotope composition of ore minerals associated with gold.