

Gold chemistry of the Witwatersrand-type Jacobina gold deposits in Brazil

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The Jacobina gold deposits are the main Witwatersrand-type gold deposits in Brazil (1). They have been mined since the 18th century and since 2006 operated by Yamana Gold Inc. who reports total gold resources of 9.7 million oz, including 1.5 million oz produced to date (2). Like in the Mesoarchaeon Witwatersrand Basin in South Africa, Jacobina gold occurs associated with quartz pebble conglomerates, which, however, experienced a greater extent of post-depositional metamorphism, deformation and fluid-induced alteration.

Microscopically, gold occurs in a variety of forms: as rounded, elongated, platy and irregular grains free in the conglomerate matrix; as inclusions in both pyrite and quartz clasts; and remobilized in quartz veins. Most of the grains preserve some of the primary sedimentary characteristics and resemble detrital Witwatersrand gold.

In this study we used a JEOL JXA 8800L electron-microprobe at the University of Wuerzburg, Germany to determine the Jacobina gold composition. A total of 368 microprobe analyses were conducted on 155 gold particles from 9 different conglomerate units (reefs) and 3 other occurrences on the Jacobina mine. Gold was analyzed for 6 elements, namely Au, Ag, Hg, Cu, Pt and Pd.

The analyzed gold contains up to 6.83 wt.% Ag and up to 0.57 wt.% Cu. This composition is unique if compared with other Witwatersrand-type gold deposits, which invariably contain Hg and higher Ag contents (3, 4, 5, 6). Presently, it is difficult to determine whether Jacobina gold originally had alloyed Hg. If so, Hg and perhaps some Ag may have been lost during metamorphism. Considering the high heat influx from a great mass of mafic-ultramafic intrusive rocks nearby, diffusion is the most likely mechanism that modified the original gold composition.

Differences exist in the Cu and Ag distribution in gold in different stratigraphic positions. Gold from The Lower Conglomerate Unit (FW Main reef) contains around 2 wt.% Ag, the Lower Unit of the Upper Conglomerate (LVLPC, MU, LU and MSPC reefs) around 1wt. % Ag, and the Intermediate Unit of the Upper Conglomerate (Holandês, Liberino and Piritoso reefs) around 3 wt.% Ag. This characteristic supports the idea of a provenance-controlled gold composition and consequently supports a hydrothermally modified paleoplacer model for the Jacobina gold.

(1) Frimmel H E (2014) Society of Economic Geologists Special Publication 85: 209-234

(2) Marques G (2016) Brazilian Symposium on Mineral Exploration, Ouro Preto, Brazil: <http://www.adimb.com.br/simexmin2016/palestras/>

(3) Frimmel et al. (1997) *Mineralium Deposita* 32: 523-530

(4) Frimmel et al. (1993) *Economic Geology* 88:249-265

(5) Reid et al. (1988) *Mineralium Deposita* 23: 211-217

(6) von Gehlen (1983) *Mineralium Deposita* 18: 529-534