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Discussion of the Disseminated-Gold-Ore-Occurrence Model

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INTRODUCTION

The ultimate objective of the 1982 workshop was, if possible, to develop an ore-occurrence model for the disseminated-gold-deposit type. Such a model should assure a common vocabulary and body of factual data that define the common classifiable deposit characteristics and lead to the systematic identification of favorable geologic environments of deposition. Several ore-occurrence models for other types of deposits at various qualitative and quantitative levels have been created to organize data systematically for meeting special-purpose needs (Erickson, 1982; Cox, 1983a, b), but the seeming diversity between sediment- and volcanic-hosted disseminated gold occurrences appeared, at the outset, to pose difficulties in arriving at a simple model. Options for framing a model were considered first, and the elements composing one followed.

Recently, two types of occurrence models have been developed, each of which provides an example of model technology. A genetic-geologic uranium model, for example, encompasses the widely ranging igneous, sedimentary, and metamorphic environments in which uranium forms (Finch and others, 1980). The environment and processes of formation of deposits thought to have a common origin are considered in a time-process sequence. The matrix is intended to consider every event, condition, and process that influenced mineralization, and thus aid in evaluation of the resources. As an example of the second type of model, the computer program "Prospector" (Duda, 1980) was designed for the identification or recognition of specific types of deposits (for example, porphyry copper, massive sulfide) and links field and laboratory observable or inferred evidence with an inference network of plausible rules based on probabilistic reasoning. Such a model provides a systematic methodology for creating a useful resource model and may assist in evaluating geologic terranes and the discovery of unrecognized resources.

The consensus of the workshop was that a definitive or quantitative model, such as those described above, may be premature for disseminated gold deposits; however, documentation of the geologic attributes as well as of existing gaps in data is an important first step in establishing the status of knowledge.

d. Alteration/zonation ----	See E3 and F3a above. Some limestone of the Roberts Mountains Formation in the mine has been weakly silicified.
e. Oxidized or carbonaceous materials.	The gold ore zone is strongly oxidized at Gold Acres (see F3a above). Carbonaceous material occurs in the limestone of the Roberts Mountains Formation. Some thrust blocks of carbon-rich silty limestone in the mine have had part of the original calcite and dolomite removed and are now coal black. Solution chemistry has not been studied.
f. Chemical evolution -----	n.d.
5. Source of elements --------	The trace-element suite associated with the gold mineralization at Gold Acres is similar to that associated with many low-temperature gold deposits around the world. This observation suggests that the gold may have a source derived from silicic igneous rocks of the kind commonly found at these gold deposits.
6. Geophysical signatures	
a. Gravity ---------------	n.d.
b. Magnetic --------------	A magnetic high centered over the Gold Acres area (Philbin and others, 1963; Wrucke and others, 1968) is thought to reflect the granitic pluton that underlies the area.
c. Induced polarization ---	n.d.
d. Seismic ---------------	n.d.
e. Radiometric -----------	n.d.
7. Summary of apparent depositional environment.	See F3e.
8. Byproduct metals ---------	Silver was produced from the gold ore at Gold Acres during the period 1942-61. Annual production averaged 9.8 percent Ag and ranged from 5.9 to 13.8 percent Ag.
G. Summary, features for resource evaluation.	The so-called gold suite of trace elements--that is, As, Au, Hg, Sb, W, and, locally, other elements--is the principal geochemical guide to the type of deposit at Gold Acres. This type of deposit can occur in the upper or lower plate of the Roberts Mountains thrust in Nevada and should be looked for in the brecciated and intricately slices lower part of the allochthon.

Hasbrouck Peak, Nevada

[Data from R. P. Ashley. n.d., no data available]

A. Name/location ----------------	Hasbrouck deposit, Hasbrouck Mountain, 8 km SSW. of Tonopah, SE1/4 sec. 28 and NE1/4 sec. 33, T. 2 N., R. 42 E., Esmeralda County, Nev.
B. Deposit type ----------------	Volcanic-hosted disseminated gold, with hot-spring features in upper parts.
C. Other examples --------------	Round Mountain, Bodie (in part), Hayden Hill(?), McLaughlin(?).
D. Regional attributes	
1. Presence of gold ----------	A northwest-trending belt in western Nevada and eastern California containing many epithermal precious-metal deposits, most associated with volcanic rocks.
2. Terrane ------------------	Roberts Mountain allochthon (Paleozoic), foreland(?) of the Golconda thrust belt (Mesozoic), active subduction followed by backarc extension and (or) continental rifting (Tertiary).
3. Basement -----------------	Pb and Rb-Sr isotopic data indicate near edge of Precambrian craton (to east). Near east edge of Sierran plutonic belt (plutons in vicinity are Jurassic in age).
4. Igneous association -------	Most rocks are basinal sediment with abundant silicic volcanic component. Silicic plugs nearby, possible small dikes in vicinity of deposit. Sediment includes interbedded hot-spring sinters.

5. Structural regime --------- Walker Lane structural zone of right-lateral displacement, also coeval basin-and-range extension faulting. Possibly on margin of buried caldera.

6. Level of erosion ---------- Oe zone near and at present surface; much of the ore body is preserved in a topographic high. Sinter preserved near the top of the deposit suggests that present erosional level was close to the paleosurface at time of mineralization.

E. District attributes

1. Host rocks ---------------- Volcanic sediment, including tuffaceous shale and sandstone, coarse tuff and lapilli tuff, and volcanic conglomerate of the Siebert Formation of Bonham and Garside (1979). Age range, 13 to 17 m.y.

2. Traps --------------------- Intense alteration (silicification) is localized along relatively coarse permeable beds and along small high-angle faults. Hydrothermal brecciation of the silicified rocks provided space for later-stage gold-bearing quartz, which forms breccia fillings and fracture fillings.

3. Preparation --------------- Hydrothermal alteration (silicification) and hydrothermal brecciation

4. Size ---------------------- Similar mineralization occurs locally in sedimentary rocks of the Siebert Formation over an area of at least 10 km^2. Past production from this type of mineralization is minor. Spatially closely associated with Ag-Au mineralization of the Tonopah district (mineralization slightly older) and the Divide district (mineralization nearly coeval).

5. Extensions ---------------- Only modest additional tonnages are likely to be found around the known ore bodies. There is a fair to good possibility that more ore bodies may exist at greater depths. A much larger area than that presently known may be prospective for new ore bodies.

F. Deposit attributes

1. Host rocks ---------------- Silicified tuffaceous shale and sandstone, coarse tuff, lapilli tuff, and volcanic conglomerate.

2. Size/shape ---------------- Horizontal projection of ore body covers area of about 1 km^2. 5 million ton (4.5 million t) at an average grade of 0.1 oz Au/ton (3.4 g Au/t), with a cutoff grade of .04 to .05 oz Au/ton (1.4 to 1.7 g Au/t), which represents about 500,000 oz Au (15.3 million g Au). At this cutoff grade, the ore body has root zones that extend downward from the main ore mass, which is shaped like a thick disc.

3. Physical characteristics

a. Ore/gangue mineralogy -- Ore: Gold with simple sulfide assemblage, mostly pyrite and minor chalcopyrite and argentite. Gangue: Quartz and adularia in veinlets and silicified rock. Silicified rock is replacement quartz with mosaic texture.

b. Structures ------------- Irregular areas representing silica fillings of hydrothermally brecciated parts of silicified masses, as well as representing microfracture-controlled disseminations in silicified masses.

c. Textures --------------- Quartz veinlets filling silicified-rock breccias and fracture fillings are banded, some bands are relatively rich in sulfides and, probably, gold.

d. Host-rock type/age ----- Volcaniclastic rocks, mainly silicic, including tuffaceous shale and sandstone, coarse tuff and lapilli tuff and volcanic conglomerate, with interbedded sinter. Lapilli tuff is predominant in the mineralized part of the section. Ages of host rocks, mineralization, and nearby silicic plugs are all approximately coeval at 16 m.y.

e. Paragenesis ------------ Quartz-sulfide-gold is always later than quartz-adularia flooding (silicification). Details of paragenesis unknown.