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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.

c. Associated anomalies ---	As, Hg, Sb.
d. Alteration/zonation ----	Carbon redistribution, clay mineral formation, limonite staining, calcite in ore zone.
e. Oxidized or carbonaceous materials.	Iron oxides, sulfates, and organic carbon.
f. Chemical evolution -----	n.d.
5. Source of elements --------	n.d.
6. Geophysical signatures	
a. Gravity ----------	n.d.
b. Magnetic ----------	n.d.
c. Induced polarization ---	n.d.
d. Seismic ----------	n.d.
e. Radiometric ----------	n.d.
7. Summary of apparent depositional environment.	Primary rock types formed in deep-water miogeosynclinal environment, giving rise to laminated carbonaceous rock types. Silicified (jasperoid) altered host rock near faults; low-temperature, near-surface mineral assemblage.
8. Byproduct metals ----------	Ag, Hg.
G. Summary, features for resource evaluation.	Located in a gold-bearing region, favorable host rocks, alteration zonation, and geochemical anomalies.

Maggie Creek/Gold Quarry, Nevada

[Data from W. C. Bagby, n.d., no data available]

A. Name/location ----------	Maggie Creek/Gold Quarry, 16 km northwest of Carlin, Nev.
B. Deposit type ----------	Sediment-hosted disseminated gold.
C. Other examples ----------	Carlin, Cortez, and Jerritt Canyon, Nev.
D. Regional attributes	
1. Presence of gold ----------	The deposits occur on the southwest edge of the Carlin window, which is part of the northwest alinement of similar windows, commonly referred to as the Lynn-Pinyon or Carlin belt. Gold is regionally highly anomalous in this belt, and eight known disseminated gold deposits occur within it.
2. Terrane ----------	Both allochthonous and autochthonous rocks of the Antler orogeny occur within the region.
3. Basement ----------	Cambrian sedimentary rocks are the oldest exposed.
4. Igneous association -------	Mesozoic and Tertiary plutons occur along the Lynn-Pinyon belt.
5. Structural regime ---------	The Lynn-Pinyon belt may represents an underlying major crustal flaw zone.
6. Level of erosion ----------	Erosion has cut through the Roberts Mountains allochthon and exposed autochthonous rocks within the Lynn-Pinyon belt. The absence of any significant supergene enrichment in the gold deposits within this belt suggests relatively recent exposure.
E. District attributes	
1. Host rocks ----------	Host rocks are silty finely laminated carbonaceous dolomitic limestone and carbonaceous shale and siltstone (Cress, 1972).
2. Traps ----------	Permeable horizons in Paleozoic sediment, and fracture zones associated with faults.
3. Preparation ----------	Carbonate removal, brecciation (either fault or hydrothermal), silicification, and argillization.
4. Size ----------	The district includes Maggie Creek/Gold Quarry, Carlin, Blue Star, Bootstrap, and Dee, all gold mines.
5. Extensions ----------	Potentially very good; n.d.
F. Deposit attributes	
1. Host rocks ----------	Host rocks are thin-bedded chert, shale, and siltstone sequence and an argillaceous dolomitic limestone and siltstone sequence, with minor interbedded sandstone.

2. Size/shape	Maggie Creek: 4.8 million tons (4.4 million t) containing 0.092 oz Au/ton (3.15 g Au/t); resource of 442,000 oz Au (13.9 million g Au). Gold Quarry: 175 million tons (159 million t) containing 0.046 oz Au/Ton (1.58 g Au/t); resource of 8 million oz Au (254 million g Au)
3. Physical Characteristics	
a. Ore/gangue mineralogy	Minerals present in the ore zones include pyrite, iron oxides, illite, kaolinite, alunite, quartz, and dolomite (Hausen and others, 1982).
b. Structures	The ore zones are localized in host sedimentary rock where they intersect near-vertical fault zones.
c. Textures	n.d.
d. Host-rock type/age	Host rocks are lower Paleozoic western- and transitional-facies rocks. Mineralization age unknown; possibly Tertiary or Cretaceous.
e. Paragenesis	n.d.
4. Chemical characteristics	
a. Solution chemistry	
(1) Inclusions	n.d.
(2) Stability	n.d.
(3) Solubility	n.d.
(4) Isotopes	n.d.
(5) Cause of deposition	n.d.
b. Temperature	n.d.
c. Associated anomalies	Maggie Creek: As, Zn, Ba; Gold Quarry: As, Sb, Pb, Zn, Ba.
d. Alteration/zonation	Carbonate (calcite) removal, dolomitization, argillization (illite, kaolinite, alunite), silicification.
e. Oxidized or carbonaceous materials.	Carbonaceous material is present in limestone and shale. Although most ore is oxidized, carbon-rich ore is also present.
f. Chemical evolution	n.d.
5. Source of elements	Leached(?) from Paleozoic section with input(?) from buried intrusive rocks.
6. Geophysical signatures	
a. Gravity	n.d.
b. Magnetic	n.d.
c. Induced polarization	n.d.
d. Seismic	n.d.
e. Radiometric	n.d.
7. Summary of apparent depositional environment.	The depositional environment is considered to be similar to that of Carlin: Relatively low pressure (1-2 km) and low temperature (200°-300°C).
8. Byproduct metals	n.d.
G. Summary, features for resource evaluation.	Anomalously high geochemical values for Au, As, Sb, Hg in silty dolomitic limestone and shale lithologies.

McLaughlin, California

[Data from J. P. Albers. n.d., no data available]

A. Name/location	McLaughlin deposit, Napa and Yolo Counties, Calif.
B. Deposit type	Hot-spring deposit.
C. Other examples	Baguio(?), Philippines; Kushikino(?), Japan; Wilbur Springs, Calif.
D. Regional attributes	
1. Presence of gold	McLaughlin is the only known economic deposit of its type in the Coast Ranges. Regionally, the area is known for its mercury deposits. Wilbur Springs, New Almaden, and Stayton mercury deposits all reportedly carry minor gold.
2. Terrane	The deposit occurs in the uplifted accreted terrain of the California Coast Ranges, which consists of Mesozoic ophiolitic rocks (the Coast Range ophiolite), overlying sediment of the Great Valley sequence, and underthrust and accreted sediment and ophiolites of the Franciscan Complex.