UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

LIHIR ISLAND GOLD:

A SUPPLEMENT TO U.S.GEOLOGICAL SURVEY BULLETIN 1693

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Open-File Report
87-272 a

This report is preliminary and
has not been reviewed for
conformity with U.S. Geological
Survey editorial standards.

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PREFACE

This descriptive model and the models that follow in Open File Reports 87-272 b,and c are intended as an update to Bulletin 1693 edited by Cox and Singer (1986) , and are assigned model numbers that indicate their approximate position in the deposit classification scheme used in that report. The pages of these open file reports are marked for punch-holes in the left margin so that they may be physically included in the Bulletin.

The three descriptive models in parts a and b are based on knowledge from only one deposit or district and represent a much lower level of genetic understanding than most of the models presented in Bulletin 1693. They are included here because they point to two unconventional environments for gold exploration: young volcanic craters and high-grade quatzofeldspathic gneisses. The grade-tonnage model in part c applies to the descriptive model for hot-spring gold in Bulletin 1693.

We are pleased to acknowledge the contributions of many geologists in industry and in the Geological Survey of Papua New Guinea in the preparation of these reports.

REFERENCE CITED

Cox, D.P. and Singer, D.A.,1987, Mineral deposit models: U.S.Geological Survey Bulletin 1693, 379 p.

DESCRIPTIVE MODEL OF Lihir Island Au
BY Dennis P. Cox and James J. Rytuba

BRIEF DESCRIPTION

DEPOSIT TYPE: Lihir Island Au MODEL NUMBER 25j
OTHER NAMES FOR SAME TYPE: Porphyry Au
DATE OF COMPILATION: November, 1986
PRINCIPAL COMMODITY: Au
EXAMPLES WITH REFERENCES: No other
RELATIVE IMPORTANCE: A new type of deposit containing more than 10 million ounces of gold.
DESCRIPTIVE/GENETIC SYNOPSIS: Au is disseminated in a breccia column in the root of a volcanic crater. Alunite alteration grades downward into argillic then into potassic. Highest grades at the top of the potassic zone.
ASSOCIATED OR RELATED DEPOSITS: Epithermal quartz-adularia Au. Hot-spring S.
GENERAL REFERENCES: Williamson, A.,1983, Thermal activity on Lihir Island, New Ireland Province: Geological Survey of Papua New Guinea Report 83/15, 25 p.. Other sources for this model are a talk presented by Geoff Ballantyne at the Australasian Institute of Mining and Metallurgy, Sydney, Australia, February 24, 1986, and site visits and laboratory study by the authors who greatfully acknowledge the help of Rod Davies of Kennecott Explorations (Australia) Ltd.

REGIONAL GEOLOGIC ATTRIBUTES

TECTONOSTRATIGRAPHIC SETTING: A small volcanic arc on the opposite side of the major arc from the trench, and parallel to a transform fault. See Figure 1.
REGIONAL DEPOSITIONAL ENVIRONMENT: Within remnants of young volcanic craters or calderas.
AGE RANGE: Only example is Quaternary.

LOCAL GEOLOGIC ATTRIBUTES

HOST ROCKS: Clast-supported breccia composed of high-K basalt and subvolcanic syenite and monzonite. Collapse breccia from crater wall merges with explosive and intrusion breccias deeper in the system.
ASSOCIATED ROCKS: Fine-grained equigranular syenite and monzonite.
ORE AND GANGUE MINERALOGY: Disseminated fine-grained pyrite, marcasite, and gold; magnetite at depth. Traces of chalcopyrite, sphalerite, luzonite, molybdenite, and tennantite. Quartz is very rare.
WALLROCK ALTERATION: Intense alunite at the surface, and alunite-sulfur localized around active hot springs. Alunite grades downward to a zone of kaolinite,smectite, and illite with spotty Au values. Argillic alteration gives way approximately 200 m below the surface to a zone of intense biotite alteration and open-textured breccia containing the highest Au

grades. This breccia shows evidence of dissolution of clast and matrix material. Below this is a zone of anhydrite stockwork veins in syenite with strong potassic alteration and diminishing Au . Alteration and brecciation die out at about 500 m depth. See Figure 2.

STRUCTURAL SETTING: Brecciated extrusive and intrusive rocks in a volcanic feeder zone. Mineralization does not extend beyond the limits of the crater floor.
DIMENSIONS OF ORE IN TYPICAL DEPOSITS: 800 by 200 m.
DIMENSIONS OF ALTERATION OR DISTINCTIVE HALOS: Anomalous Au 1000 by 2000 m.
EFFECTS OF WEATHERING: Recovery of Au from the alunite cap is economic because of surface oxidation.
GEOCHEMICAL SIGNATURES: High As. Weakly anomalous Cu, Pb, Zn, Sb, Hg, and Mo. Ag generally less than 1 ppm in sulfide zone.
FLUID INCLUSIONS: Generally too small to study except in stockwork anhydrite where large inclusions were observed containing barite and celestite daughter minerals. These have salinities of about 5 percent (NaCl equivalent) and median closing temperature of 211° C.
GEOPHYSICAL SIGNATURES: Not known.
ORE CONTROLS/EXPLORATION GUIDES: Low-grade Au in alunite that bottoms abruptly in argillic alteration is a candidate for this model. A potassic alteration zone with high Au grades may lie a few hundred meters below.

MODEL-CLASS ATTRIBUTES

GRADE-TONNAGE CHARACTERISTICS: The only example contains 137 million tonnes at 2.66 grams Au per tonne including 49 million at 4.5 grams.
ESTIMATED LEVEL OF GENETIC UNDERSTANDING (SCALE OF 1 TO 10): 2
SIGNIFICANT UNANSWERED QUESTIONS: Is alkalic volcanism an important attribute? Is the anhydrite stockwork related to Au mineralization or to later flooding by sea water?
SPECULATIONS ABOUT ANSWERS TO THESE QUESTIONS: More examples are needed.

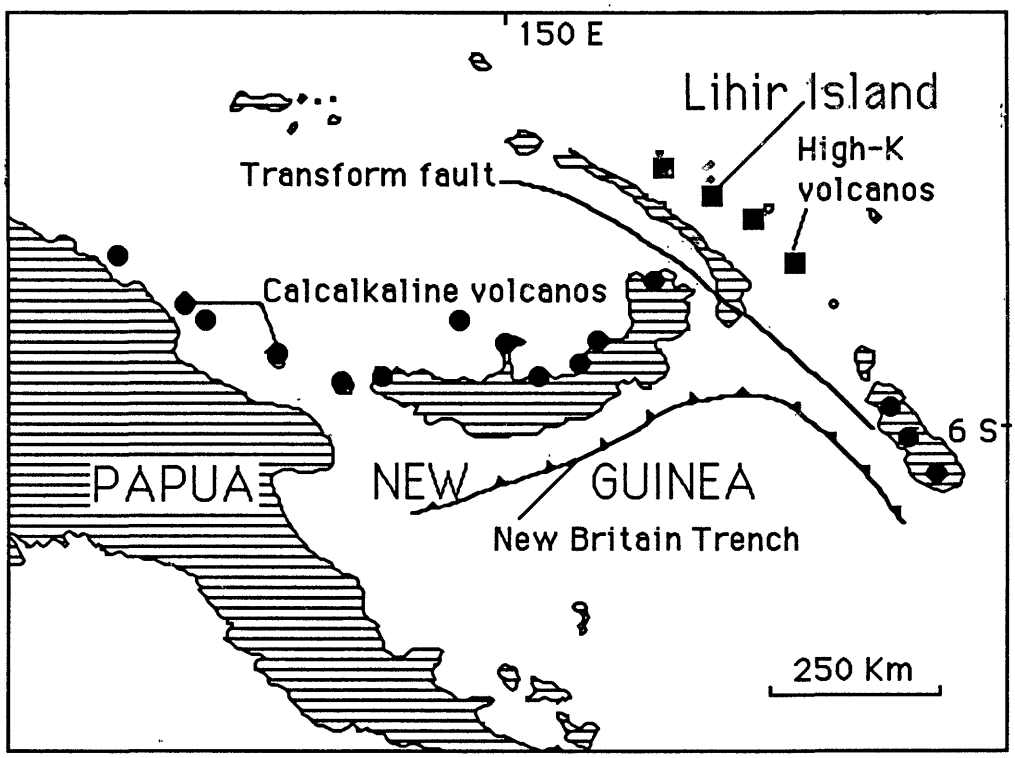

Figure 1. Map showing the tectonic environment of Lihir Island.

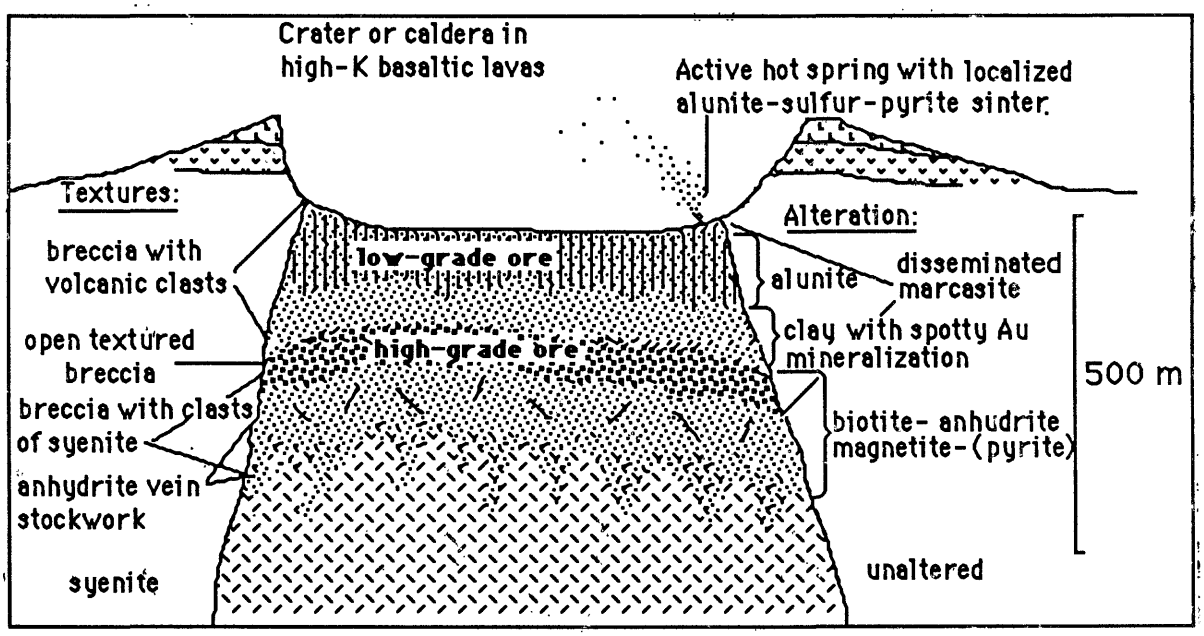

Figure 2. Idealized cross section showing distribution of breccia textures and zoning of ore and alteration at the Lihir Island gold deposit.