RELATIONSHIPS BETWEEN THE COCHAS-GRAN BRETAÑA REVERSE FAULT AND THE AZULCOCHA Zn-As-(Au) ORE DEPOSIT, CENTRAL PERU

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Key Words: Zn-As-(Au) deposit, hydrothermal karst, fracture control, central Peru.

Setting and tectonic evolution

The Azulcocha area lies between the eastern part of the Western Cordillera and the high plateau of the Peruvian Andes. about 45 km west of Huancayo (about 12°S and 75°03'W at 4500 m above sea [illegible] orebody is emplaced along the Cochas-Gran Bretaña fault (Fig. 2). Between 1968 and beginning of 1986 1.5 million tons with 18% Zn and 2% As were exploited.

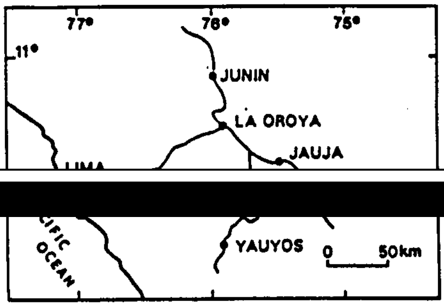

Fig. 1. Location of the Azulcocha area

Mesozoic and Cenozoic sediments as well as Cenozoic granite-monzonite intrusive-rocks occur in the studied area (Figs. 2 and 3). The Cochas-Gran Bretaña fault constitutes the most important tectonic element. Its main movement, as well as that of similar faults like those of Carmen Chico-Cerro de Pasco and of Casaracra-Junin Lake, is associated with the Quechua II and III phases (MEGARD 1978, SOULAS 1975). [illegible]

E-W and dips between 30° and 45°S (Fig. 3). This is a transverse orientation with respect to its general NW-SE

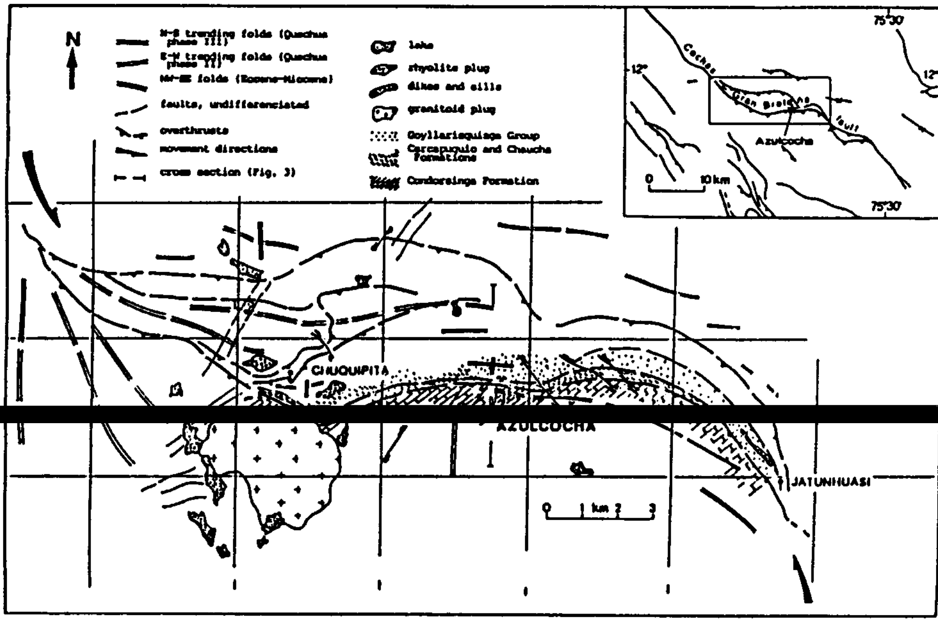

FIG. 2. GEOLOGIC SKETCH OF THE JATUNHUASI-AZULCOCHA-CHUQUIPITA AREA, INDICATING THE MAIN TECTONIC ELEMENTS (MODIF. AFTER MEGARD, 1979 AND SOULAS, 1975)

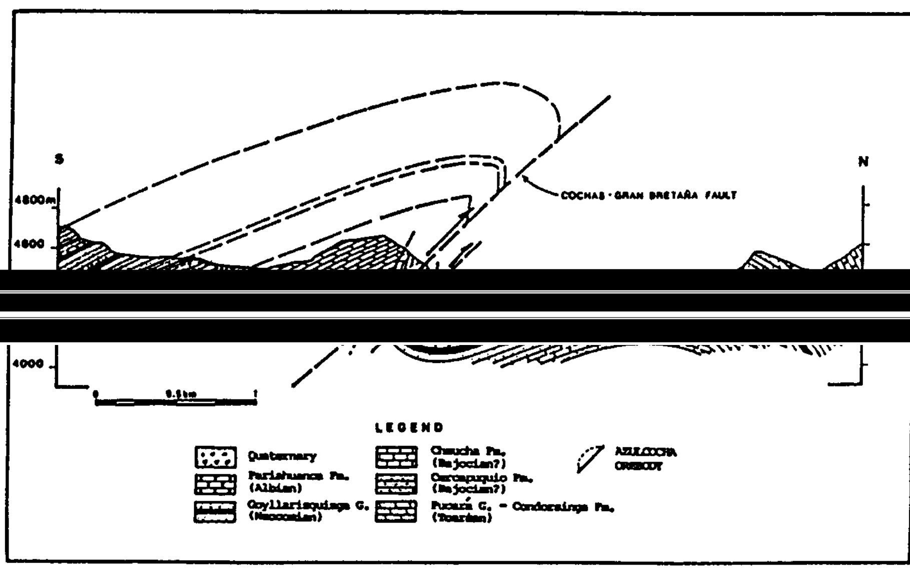

FIG. 3. N - S CROSS SECTION OF AZULCOCHA ORE DEPOSIT

direction (Fig. 2). The transverse segment is characterized by overthrusting in contrast to the dominant dextral slip movement of the longitudinal parts of the fault. The south block consisting of limestones of the Condorsinga Formation is thrusted over sandstones of the Goyllarisquizga Group. East and West of the mining area the fault affects also the Cercapuquio and Chaucha Formations. The Cochas-Gran Bretaña fault represents actually a set of parallel faults which strongly deform the affected rocks. Silt intercalations of the Goyllarisquizga sandstones react plastically producing apparent "dikes". Carbonate rocks are intensely fractured and brecciated, favoring subsequent karstification. N30°-40°E faults with left-slip displacement are interpreted to be linked to N-S shortening of the Quechua II phase which also formed the E-W folds and deformed older folds. The compressive pulses of the Quechua III phase produced N-S folds (Azulcocha mine syncline), and a fault system trending N120°-130°E (sinistral) and N30°E (dextral).

The Azulcocha ore deposit

The Azulcocha Zn-As-(Au) deposit consists of an elliptical orebody (300x50x160m) emplaced in Condorsinga limestones and controlled and limited by the Cochas-Gran Bretaña fault (Fig. 3). The ore occurs dominantly as open space filling, in part cementing carbonate fragments in collapse breccias. The ore appears mainly as colloform textures consisting of very thin whitisch-yellow to dark-brown sphalerite layers (schalenblende), marcasite, pyrite, and melnikovite (MUÑOZ, 1986).

Four depositional stages have been distinguished (Fig. 4). Massive aggregates of pyrite and marcasite, in part as subidiomorphic grains, and disseminated sphalerite in limestone are assigned to stage I. Stage II comprises mainly schalenblende, subordinate barite and marcasite, and minor amounts of galena and Pb-As-sulfosalts (jordanite, baumhauerite and dufrenoysite). This stage displays several repetitive sequences which often are interrupted by brecciation and cemented by a next deposition puls. Pyrrhotite with "birds eye" texture is occasionally observed. Stage III consists of marcasite and melnikovite. Microprobe analyses show that they contain up to 500 ppm Au and up to 7% As. Abundant realgar and auripigment with small acicular inclusions of Pb-As-sulfosalts occur also in this stage III. Stage IV represents supergene oxidation

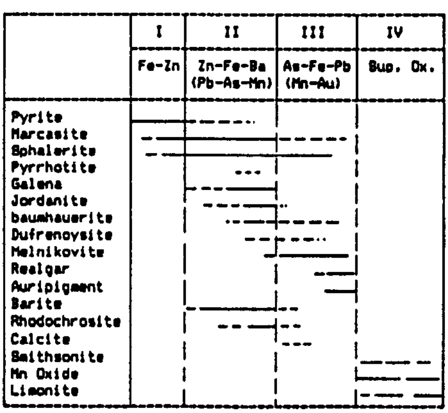

Fig. 4. Schematic paragenetic sequence

sphalerite generations are richer in Fe (up to 1.5%). Cd- and Mn-values range between 0.3-0.5% and 0.05-0.1% respectively. As a whole the Azulcocha mine shows a relatively large variety of ore minerals and a broad spectrum of elements (Tab. 1). The relatively high contents on Au should be pointed out.

Table 1. Trace element contents in selected ore samples from the Azulcocha mine. ICP and ICP-MS (*) analysis, except for Au (Acid leaching/AA). Results for elements contained mainly in gangue minerals (Ca, Mg, Al, K) are also given. Other elements not included in the table: B < 20ppm, Na < 100ppm, P < 100ppm, Ti < 100ppm, Mo < 6ppm, Rh* < 0.2ppm, Ag < 2ppm, Ba < 5ppm, La < 2ppm, Re* < 0.2ppm, Os* < 2ppm, Ir* < 0.1ppm, Bi* < 0.2ppm, Th* < 1ppm and U* < 0.4ppm. ZO = zinc ore, IO = iron ore.

Sample	Descr.	Zn %	Pb %	As %	Fe %	Mn %	Ga ppm	Ge ppm	Cd ppm	In ppm	Sb ppm	Te ppm	Hg ppm	Tl ppm	Cu ppm	Ni ppm	Co ppm	V ppm	Cr ppm	Au ppb	Ca %	Mg %	Al %	K %
AZ-040-01	ZO-IO	>4	1.07	2.6	14.3	0.02	4	92	196	0.3	42	0.4	18	21	21	9	7	2	10	121	0.02	0.01	0.11	0.03
AZ-040-02	IO	0.1	0.02	0.1	8.4	0.05	2	1	3	0.1	1	0.1	<1	8	123	57	66	40	22	24	0.03	0.01	0.58	0.07
AZ-0-01	ZO-IO	>4	1.38	>4	8.6	0.04	4	26	1368	10.0	430	25.8	68	40	13	4	3	1	2	1560	0.01	0.01	0.02	0.01
AZ-0-02	ZO-IO	>4	1.29	>4	7.6	7.88	9	22	1248	3.2	375	2.2	71	82	6	1	4	3	6	960	0.13	0.01	0.05	0.03
AZ-0-03	ZO-IO	>4	0.25	4.0	12.0	6.50	4	27	738	7.9	111	0.3	69	106	15	1	6	6	10	350	0.20	0.11	0.05	0.02
AZ-0-04	ZO-IO	>4	0.09	0.3	11.3	9.37	2	14	900	5.0	14	0.6	17	34	3	1	5	6	4	74	0.34	0.15	0.03	0.01
AZ-0-05	ZO-IO	>4	0.94	0.4	10.1	6.53	4	23	2364	4.3	143	3.4	80	116	7	1	5	4	6	44	0.29	0.08	0.07	0.02
AZ-0-07	IO-ZO	3.3	0.04	0.1	11.0	1.93	2	1	97	0.3	14	0.2	9	3	16	15	6	14	24	77	5.94	3.24	0.11	0.04
AZ-40-01	ZO-IO	>4	1.24	>4	7.8	1.56	10	19	936	13.2	659	3.2	118	70	14	4	3	2	5	14040	0.11	0.01	0.03	0.01
AZ-40-02	ZO-IO	>4	0.11	2.1	9.6	6.95	2	34	917	3.7	18	0.9	17	74	7	1	4	3	3	360	0.17	0.04	0.03	0.01
AZ-40-03	ZO-IO	>4	>2	>4	9.5	0.03	6	113	2040	39.2	179	8.6	64	29	11	4	4	1	6	1020	0.01	0.01	0.04	0.02
AZ-60-01	IO-ZO	1.3	0.10	>4	19.4	3.83	2	1	85	1.4	25	5.6	50	122	13	1	9	3	2	1	0.06	0.01	0.04	0.01
AZ-60-02	IO-ZO	>4	>2	>4	13.9	0.05	5	82	923	21.5	405	0.3	70	33	17	5	7	3	5	1180	0.01	0.01	0.08	0.03
AZ-60-03	IO-ZO	>4	0.25	4.0	12.4	3.44	3	31	896	6.7	70	2.9	48	99	16	7	7	4	7	930	0.08	0.03	0.07	0.03
AZ-95-01	ZO-IO	>4	>2	>4	7.1	6.90	2	8	935	4.3	106	7.2	34	190	7	1	3	2	3	770	0.11	0.01	0.02	0.01
AZ-95-02	ZO-IO	>4	>2	>4	10.4	0.41	3	11	2460	3.2	1170	19.2	121	279	11	1	3	1	6	1800	0.03	0.01	0.02	0.01

Homogenization measurements of fluid inclusions on barite yield two populations with temperatures of 180°-230° and 250°-290°C. Alterations is not observed in the mine itself; however, silicification and dolomitization linked to N30°E faults is recognized south of the ore deposit.

The Azulcocha orebody has been precipitated in a large cavity produced by dissolution and collapse brecciation through hot fluids along an overthrust surface of the Cochas-Gran Bretaña fault. The occurrence of ore fragments sealed by new sulfide generations indicates that the fault experienced some movement during ore formation. However, ore deposition appears to have started after the main fault movement during the Quechua II phase, for ore brecciation is subordinate compared to that in adjacent mylonitized host rocks.

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