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Siphon Trap Mineralization Model in Late-collisional Setting and Related Ore-prospecting Model of Carlin-type Gold Deposits of West Qinling in Gansu

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1 Introductioin

West Qinling is one of important metallogenic belts of Carlin-type gold deposits (Chen et al, 2004; Pu et al, 2003; Mao et al,2002), in which there are 72 Carlin-type gold deposits or 9 large or super-large gold deposits. Following states metallogenic characteristics of the Carlin-type gold deposits from seven aspects as tectonic deformation, etc., furtherly, a siphon trap mineralization model with a relatecd propecting model for Carlin-like gold deposits is put forward.

2 Regional Tectonic Deformation and Orogenic Process Since Late-Palaeozoic

Stratigraphy (Yang et al, 1994) shows the West Qinling block and the Songpan block had both been parts of the Yangtze block, and had been split from the Yangtze block during Paleozoic. The polarity of subduction-related intrusives developing orderly across north Qinling, middle Qinling, and south Qinling, with their ages as Silurian, Permian, middle Triassic, respectively, proved that The Yangtze block together with the Songpan block had moved northward since Caledonian, and started a subduction with North China block in the northeast part of the West Qinling, and subsequently the subduction ages were Hercynian in the north part and Indosinian in the northwest part, while the sedimentary cover developed folding deformation. During late period of Late Triassic (220-200Ma) to early period of Late Jurassic (205-191Ma), the collision zone was in late collision setting, which orderly experienced short-period of thermal relaxation, and intense intracontinental subduction. During middle-late Jurassic (160-140 Ma), the tectonic regime in North China transformed greatly to multi-directional compression, while most of the West Qinling was still undergoing through the north- to south-trending intra-continental subduction and brittle deformation. During late period of Paleogene to early period of Neogene(60-50Ma), the lithosphere of West Qinling was in squeenzed state and NEE-directed strike-slip faults intensively active as a result of northward intracontinental-subduction of Lhasa block and southward movement of Siberian plate.

3 Both Deep Fracture and Intrusives are Ore-carrying Stuctures

Most of Carlin-type gold deposits locate within 15Km from deep fractures and within 14Km form intrusives, that imply the deep fractures play the same role as intrusives in the ore-forming process, or might be interpreted as both are ore-carrying stuctures, and metallogenic structures are their secondary faults or intrusive contact structures.

4 Flysch Formation is Favorable Host Rock

Carlin-type gold deposits mainly developed in Devonian and Triassic, in which flisch formation dominantly occurs, and the flisch formation is more favorable host rock of the deposits.

5 Metallogenic Material Coming from Basement of Flisch Formation or Subduction Block

Except Devonian Shujiaba Formation (D_2sj) is characterized by higher gold concentration (1.83×10^{-9}), the rest of Devonian and Triassic host formations are low gold concentration, but fowllowing strata are characterized by higher gold concentration ($1.69\text{-}2.63\times10^{-9}$) and are possible to serve as ore source, i.e. the basement strata of Bailongjiang Group (S*B*), Devonian Shujiaba Formation

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(D_2sj) and Carboniferous Minhe Formation(Cm), and the subduction strata of Triassic Zagunao Formation (T_3z), Tazang Formation($T_{2\text{-}3}tz$), Zagashan Formation(T_2zg). The geochemical characteristics of trace elements proved that the intermediate-acid intrusives were derived from partial melting of Bikou Group as mid-crust (He et al,2011).

6 Metallogenic Dynamics Implied by Metallogenic Structures in Mining Districts

The ore-controlling structures of large-superlarge sized gold deposits may be classified as following four type of deformation: detachment fault between geological Formations, hinge zone of anticline and interlayer fault in limbs of anticline, high angle thrust faults with compresso-shear, and intrusive contact stuctures. It shows that the mineralization developed under persistent compresso-shear stress, and the siphonage of compresso-shear growth fault is one of important patterns for deep-source hydrothermal mineralization.

7 Tectonic Regime Corresponding to Diagenetic Ages of Intermediate-acid Intrusives and to Metallogenic Ages of Gold Deposits

The highest peak of diagenetic ages is at 240-200 Ma, and two weaker peaks are at 180-160Ma(J_2-K_1^1) and 40-20Ma($E_{2\text{-}3}$-N_1), respectively. The highest peak of metallogenetic peaks is at 200-180 Ma, and two weaker peaks are at 160-140Ma(J_3) and 60-40Ma($E_{1\text{-}2}$), respectively.

Comparing tectonic regime of diagenesis to that of mineralization, we found that magmatism and minralization developed in thermal relaxation setting and intracontinental subduction setting, respectively. It is consistent with ore-forming setting of Carlin-type gold deposit in Nevada, US (Hofstra A C J., 2000; Pu et al, 2003).

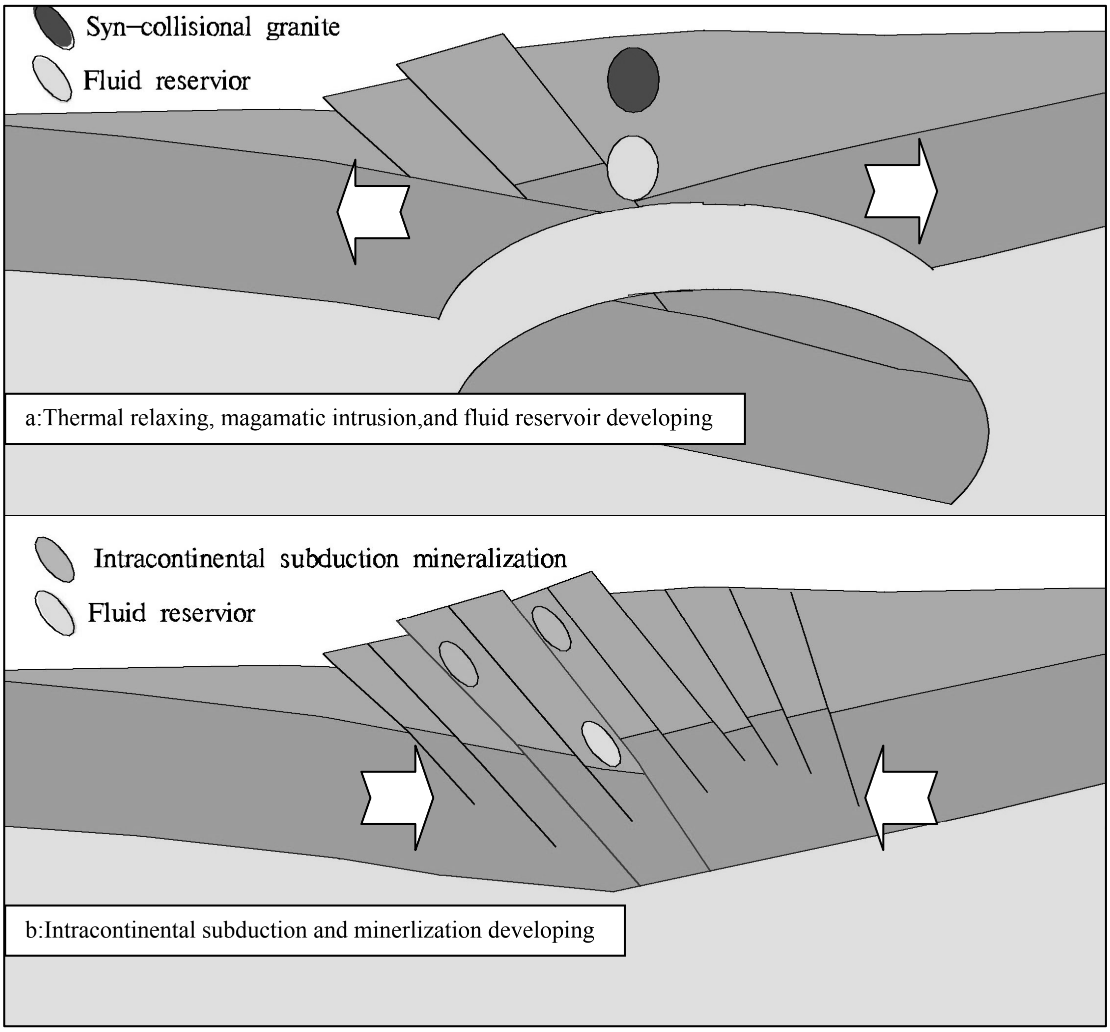

Fig.1 Metallogenic model of Carlin type gold deposit in West Qinling

8 Siphon Trap Mineralization Model in Late-collisional Setting and Related Ore-prospecting Model

8.1 Siphon trap mineralization model in late-collision setting

(1) In main collisional stage, with the increasing of subduction depth and the crustal thickness, the subduction block started to partial melting and finally resulted in syn-collision granitic magmas.

(2) In early period of late collisional stage, with breaking off of the front part of subduction slab, the collisional zone got to thermal relaxation, the magmas related to subduction and syn-collisioin intrading themselves up into upper crust, and ore-fluid in geological formations gradually flow into remained magmatic channel or deep fracture to build a fluid reservoir (Fig.1 a).

(3)Two blocks intensively collided with each other, the large-scale intracontinental subduction and low temperature mineralization happened in the upper crust (Fig.1 b).

8.2 Prerequisite to form a large-sized gold deposit and its prospecting model

According to seepage theory in broken media, following expressions was derived from fractured media (Zhang, 2003):

$$\upsilon_i = -K/\mu \cdot \frac{\partial p}{\partial i} = -\frac{K_0 a}{\mu} \exp(\sigma - \sigma_0) \cdot \frac{\partial p}{\partial i} \quad ,$$

where μ, p, and υ denotes viscosity, internal pressure, and velocity of metallogenic fluid, respectively. With the driving of tectonic stress, there would be persistent flowing of hydrothermal solution, and the velocity of metallogenic fluid would explosively jump. The fluid reservoir in depth, ore-carrying fracture and tectonic trap are prerequisite to form a large-sized gold deposit, the intrusives and deep fracture serve the same role as ore-carrying fractures, and the local extensional fields in sedimentary cover which had been developing under compressing or simple shearing regime are favourable metallogenic places.

The ore-prospecting model of Carlin type gold deposits is:

Ore-carrying fracture (deep fracture or intrusives) and metallogenic structure (local extensional field such as anticline) and wall rock alteration (evidences of metallogenic fluidization).

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References

Mao Jingwen , Qiu Yumin , Richard J Goldfarb et al. 2002. Geology ,distribution , and classification of gold deposits in the western Qinlingbelt ,central China. Mineralium Deposita ,37 :352-357.

The Songpan-Ganzi block: its rerlationship with Qinling fold belt and Yangtze plateform and development. Acta Geologica Sinica, (3), 209–219 (in Chinese with English abstract).

He J.Z., Yao S.Z., 2011. Geochemical evidence for the orogenic process of West Qinling in Gansu since Neoproterozoic and its metallogenic background. Geology in China, 38(3), 650–651 (in Chinese with English abstract).

Li Jiliang, Sun Shu, Hao Jie,et al,1999.On the classification of collis10n 0rogenic belts. Scientia Geologica Sinica, 34 (2):129- l38(in Chinese with English abstract).

Hofstra A C J. Characteristics and models for Carlin-type golddeposits[J]. Reviews in Economic Geology,2000,13:163—214.

Chen Yanjing,Zhang Jing,Zhang Fuxin,et al. Carlin and Carlin-1ike Gold Deposits in Western Qinl ing Mountains and Their Metal l ogenic Time,Tectonic Setting and Model.Geological Review, 50(2):134-152(in Chinese with English abstract).

Pu Chuanjie, Gao Zhenmin,2003. A COMPARISON STUDY ON CARLIN2TYPE GOLD DEPOSITS AT HOME AND ABROAD.Yunnan Geology, 22(1):27-38(in Chinese with English abstract).

Zhang Jun,2003.On the theory and method for the forcasting of the concealed orebody location, using the hydrothermal-vein-like gold deposit as an example. Beijing: Geological Publishing House,14-21(in Chinese with English abstract).