A Structural Ore-Control Model for Carlin-Type Gold Deposits, Youjiang Basin, China

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Carlin-type Au deposits are hydrothermal replacement bodies hosted primarily within carbonate rocks, in which Au occurs mainly as a solid solution within disseminated pyrite. The Youjiang Basin in Southwest China represents the second largest known concentration of these deposits globally, second only to Nevada, USA. The orebodies of the Youjiang Carlin-type Au deposits can be classified into two types: "fault-controlled" and "strata-bound". Fault-controlled orebodies are localized along high-angle reverse faults. In contrast, stratabound orebodies derive their name from their layered or layer-like morphology.

This study utilizes fault-related fold theory to propose a structural ore-control model explaining these two types of orebodies. Central to this model is the development of bedding-parallel detachment faults, typically localized along interfaces such as unconformities or major lithological contacts. These interfaces exhibit a marked competency contrast, separating an underlying competent footwall unit (e.g., limestone or dolostone) from an overlying incompetent hanging wall sequence (e.g., an argillaceous-calcareous clastic succession).

During regional deformation, the incompetent hanging wall shortens and thickens significantly, while the competent footwall remains relatively undeformed. This differential strain concentrates slip along the detachment surface. Continued shortening within the hanging wall creates detachment folds above this primary slip surface. Where folding intensity exceeds the rock mass rupture strength, bedding-parallel slip transitions to strata-cutting thrusting initiated from the detachment horizon. This process generates a fault-propagation fold geometry, characterized by thrust displacement diminishing towards the fault tip as slip is progressively converted into folding of the hanging wall.

In this model, detachment folds are linked to the development of “strata-bound” orebodies, while fault-propagation folds control the formation of “fault-controlled” types. This model stresses the importance of these specific fault-related folds, originating from competency contrasts between footwall and hanging wall units, in localizing mineralization. This understanding provides a basis for potential breakthroughs in exploration for Youjiang Carlin-type gold deposits.