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Structural Interpretation of New High-Resolution Aeromagnetic and Radiometric Data in Central Iran

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From 2010, regional high-resolution airborne geophysical surveys were undertaken in central and northwestern Iran, commencing with 140,000 km^2 from Esfahan to Gonabad, at 500-m line spacing. Interpretation of these data sets provides unprecedented resolution of the structural geometry of central Iran, which is mostly under cover. Central Iran consists of a mosaic of continental blocks separated by complex fold and thrust belts that are transposed into strike-slip crustal sutures due to ongoing noncoaxial or rotational deformation. Prior to anticlockwise rotation of the Central Iranian Microcontinent, tectonic activity in central Iran was dominated by opening and subsequent closure of two temporally overlapping Tethyan Oceans: the northern (current azimuths) Paleo-Tethys Ocean and the southern, younger, Neo-Tethyan Ocean. Oblique convergence and strike-slip tectonics due to oblique subduction of the Neotethys to the south of the Central Iranian Microcontinent during Early-Middle Cimmerian events are commonly cited.

Whereas previously interpreted major structures are depicted as single, discontinuous faults, based on relatively sparse data through areas of cover, the new structural interpretation precisely positions these structures and demonstrates that they comprise composite, anastomosing, kinematically related fault groups that bound well-defined tectonic terrains. Anticlockwise rotation of the Central Iranian Microcontinent is confirmed by widespread dextral shearing during the Late Triassic-Lower Cretaceous across the Kashmar-Kerman tectonic zone, between the Yazd and Tabas blocks. This resulted in localized, near-field stresses and the development of at least three triangular or cuspate “keystone blocks,” bounded by well-defined terrains and arrayed in an east-southeast trend. A myriad of short, late-kinematic, brittle-ductile to brittle structures are superimposed on this geometry.

Three deformed, predominantly Jurassic to Cretaceous basins are structurally resolved. These show initial normal faults, which have been inverted and transposed, and rotated transverse faults. Paleogeographic reconstructions place these basins on major terrain boundaries (e.g., the Nayband and Kalmard faults for the Shotori Basin, the Anar fault for the Kharanaq Basin, the Shah-Kuh fault for the Farrokhi Basin, and the Masudi fault for the Gonabad Basin). This revised interpretation has important implications for Pb-Zn mineralization within these basins.

Relative southward movement and clockwise rotation of the Shir-Kuh Microblock is evident. Based on new interpreted data, its origin is the southwest edge of the Anarak Metamorphic Complex, approximately 200 km farther north. From ca. 12 Ma onward, development of NW-directed escape tectonics produced NNW-trending, dextral, strike-slip faults or shears, most notably the Dehshir fault, which has a dextral offset of at least 150 km. These faults overlapped temporally with both the major porphyry-forming event at ca. 14 to 12 Ma and Shir-Kuh

Microblock migration. The Dehshir fault notably offsets earlier, arc-parallel structures, predominantly SW-verging reverse faults and thrusts in the Main Zagros zone, the Sanandaj-Sirjan zone, and the Urumieh-Dokhtar magmatic arc. The Dehshir fault dextrally offsets components of the Shahr-E-Babak, Debhid, and the Shirazkuh and Heidar Abad fault zones. Other key structures, which overlap spatially and temporally with known mineralizing events, include Lower Cambrian structures, which host or control iron oxide-apatite deposits. These are geophysically resolved as laterally extensive, terrain-bounding structures that were reoriented and transposed to northwest-southeast trends around Posht-E-Badam.