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Editorial

Editorial for Special Issue "Tectonic–Magmatic Evolution and Mineralization Effect in the Southern Central Asian Orogenic Belt"

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The Central Asian Orogenic Belt (CAOB), one of the world's largest orogens, extending from the Ural Mountains in the west to the Russian and the Chinese Far East, is the result of long-lived multi-stage tectonic evolution, including Proterozoic to Paleozoic accretion and collision, Mesozoic intracontinental modification, and Cenozoic rapid deformation and uplift [1–3]. The accretionary and collisional orogenesis of its early history generated a huge orogenic collage consisting of diverse tectonic units, including island arcs, ophiolites, accretionary prisms, seamounts, oceanic plateaus, and micro-continents. These incorporated orogenic components have preserved valuable detailed information on the orogenic process and continental crust growth, which makes the CAOB a key region for understanding continental evolution, mantle–crust interaction, and the associated mineralization.

However, the architecture of the CAOB remains controversial, particularly in terms of its crustal composition, deformation, metamorphism, sedimentation, and kinematics. Furthermore, the CAOB has experienced the superimposition of different orogenic domains and has been overprinted by younger tectonism, the mechanism of which is still not understood [3]. We have assembled papers for this Special Issue of Minerals that provide new geologic, geophysical, petrological, and geochronological data and study advances in tectonic evolution and the mineralization effect in the south domain of CAOB. For this Special Issue, we have collected 15 papers, encompassing the archipelago system of the West Junggar orogenic belt, Tianshan orogenic belt, Beishan orogenic belt, and Xing-Meng orogenic belt and the northern margin of the North China Craton.

Liu et al. (Contribution 1) report zircon U-Pb chronological and geochemical research on the volcano-sedimentary strata of the Middle Devonian Kulumudi Formation in West Junggar. The zircon U-Pb age of the lithic crystal tuff is 386 ± 2 Ma, and the maximum depositional age of the sandstone is 341 ± 3 Ma, indicating that this rock unit should be redefined as belonging to the Lower Carboniferous Jiangbasitao Formation. Geochemical data and Zircon Hf isotopic data indicate that the Kulumudi Formation and Jiangbasitao Formation were both formed in a juvenile arc setting with ocean–continent subduction. It is further concluded that the southward subduction of the ocean basin represented by the Darbut–Karamay ophiolitic mélange beneath the newly accreted arc crustal segments produced a juvenile arc.

Wang et al. (Contribution 2) conducted zircon U-Pb dating, whole-rock geochemical analysis, and molybdenite Re-Os isotope chronological analysis to constrain the magma origins and the timing of mineralization for the Yuhaixi Mo (Cu) deposit in the eastern Dananhu–Tousuquan island arc, Eastern Tianshan. Zircon U-Pb dating suggests that the emplaced ages of the Yuhaixi monzonitic granite, diorite, and granite are 359 ± 2 Ma, 299 ± 2 Ma, and 307 ± 2 Ma, respectively. The Re-Os dating of molybdenite yields a well-constrained ^{187}Re-^{187}Os isochron age of 354 ± 7 Ma. Geochemical data suggest that the Yuhaixi Mo (Cu) deposit was likely sourced from the juvenile lower crust and was formed in an arc setting.

Wu et al. (Contribution 3) present a systematic study of granodiorites and bimodal volcanic rocks from the north Huitongshan–Zhangfangshan ophiolitic belt in the Southern Beishan orogenic belt. The bimodal volcanic rocks consist of rhyolite and basaltic andesite. The Early Permian granodiorites (289 ± 2 Ma) and rhyolite (272 ± 2Ma) have geochemical features similar to those of typical A_2-type granitoids. The authors conclude that the Early Permian Zhangfangshan granodiorites and Baishantang bimodal volcanic rocks formed in a post-collision extensional setting and the Huitongshan–Zhangfangshan ocean had been closed before the Early Permian.

Chen et al. (Contribution 4) report new geochronological and geochemical results for the Early Devonian plutons from the Luotuoquan complex in the eastern segment of the Southern Beishan orogenic belt, including monzogranite (405 Ma) and syenogranite (399 Ma). Geochemical data enable the authors to state that these A-type granites might occur in a post-collisional extension setting. They further point out that the closure of the Beishan Ocean occurred before the Early Devonian.

Wang et al. (Contribution 5) present petrographic, geochronologic, and whole-rock elemental analyses and Sr–Nd–Hf–O isotopic composition analyses for Paleozoic Huashigou granitoids in the South Qilian along the northeastern margin of the Tibetan Plateau. They conclude that the Late Devonian (369 ±4 Ma) and Middle Permian (262 ±1 Ma) granitic rocks were formed in the orogenic–post-orogenic extensional setting after the closure of the Paleo-Tethys Ocean and were derived from the partial melting of crustal materials at different depths.

Wang et al. (Contribution 6) present a geochronological and geochemical study on Early Cretaceous volcanic rocks (129 ± 1 Ma) from the Longjiang formation in the middle of the Da Hinggan mountains, which belongs to the Zhalantun Duobaoshan island arc. Geochemical data enable the authors to state that these rocks were formed in a superimposed post-collisional and continental arc environment, possibly associated with the Mongol–Okhotsk Ocean closure and the oblique subduction of the Pacific Plate.

Wang et al. (Contribution 7) report new geochronological, geochemical, and isotopic results for the monzogranites (209 ± 1 Ma) and rhyolitic porphyries (170 ± 1 Ma) associated with the Wunugetu deposit, situated in the southern Erguna block. They conclude that the Wunugetu deposit was formed in an active continental margin setting and was influenced by the Late Triassic–Middle Jurassic southeastward subduction of the Mongol-Okhotsk Ocean.

Zhao et al. (Contribution 8) conducted skarn mineralogy, fluid inclusion (FI), and H-O isotopic analyses for the Da'anhe deposit in the eastern section of the Xingmeng orogenic belt. The data enable the authors to state that the Da'anhe deposit is a calcareous reduced skarn Au deposit related to the metasomatism of gabbro-dioritic magma and marble in the middle-deep part of the crust. They further point out that the distinctive nature of the ore-forming magma (source, reducing conditions, and high-water content: $\Delta FMQ = 0.17$, $\log(fO_2) = -15.11$, water content = 6.80 wt.%) was key to the formation of the Da'anhe skarn gold deposit.

Na et al. (Contribution 9) studied the geochronology, petrology, and geochemistry of the Hadayang schists (360 ± 2 Ma and 355 ± 3Ma) in the eastern Xing'an block. Geochemical data indicate that the magma source of the schists was a mantle that consisted of both spinel and garnet lherzolite, with a partial melting degree of 1–5% and that it had undergone olivine, orthopyroxene, and plagioclase fractional crystallization. They conclude that Late Devonian–Early Carboniferous basic–intermediate magmatic rocks in the eastern Xing'an block were formed in an intracontinental extension tectonic setting similar to that of the North American Basin and Range basalt.

Zhang et al. (Contribution 10) conducted molybdenite Re-Os dating, H-O-S-Pb isotopic compositions, and fluid inclusion (FI) analyses on the Lower Urgen molybdenum deposit, which is situated in the northern Great Xing'an Range. Systematic data indicate that the Lower Urgen molybdenum deposit is coeval with Late Jurassic–Early Cretaceous molybdenum mineralization events in NE China and that the hydrothermal process can be divided into three stages. Isotopic data suggest that the ore-forming fluids were initially of magmatic origin, with the increasing incorporation of meteoric water, and that the ore-forming materials originated from granitic magmas.

Pan et al. (Contribution 11) conducted a systematic investigation into sedimentary rocks from the Heilongjiang Complex, NE China. They identified two episodes of orogenic events including crustal thickening, magmatic flare-up, and landward migration. The Permian crustal thickening event was caused by a shallowing subducting slab angle and thus triggered magmatic flare-ups. The shallow slab subduction enhanced plate coupling and caused the westward subduction of the Mudanjiang Oceanic Plate, generating the second flare-up in this region and the crustal thickening event.

Li et al. (Contribution 12) reported new geochronological and geochemical results for the Middle Silurian–Middle Devonian magmatic rocks in Yitong County, Jilin Province, NE China, including tonalite, basalt, andesite, and metamorphic olivine-bearing basalt. Geochemical data enable the authors to state that the Middle–Late Silurian magmatic rocks were formed in an active continental margin environment influenced by the southward subduction of the Paleo-Asian Ocean, while the Middle Devonian volcanic rocks formed in an extensional environment after the arc–continent collision.

Chen et al. (Contribution 13) conducted a systematic investigation into Permian granitic rocks in the Chifeng area, located at the junction of the Xing'an–Mongolian orogenic belt and the northern margin of the North China Craton. They conclude that the Permian tectono-magmatic evolution of the Paleo-Asian Ocean can be divided into three events: (1) Early Permian granite formed in a subduction setting; (2) Middle Permian granite formed in a syn-collision setting; and (3) Late Permian–Early Triassic granite formed in an extensional setting induced by the slab break-off responsible for the closing of the PAO.

Yu et al. (Contribution 14) present in situ pyrite trace element and sulfur isotope composition measurements from the Beiwagou Pb-Zn Deposit, Liaodong Peninsula, Northeast China. They suggest that most mineralization events occurred due to the compaction and lithification during diagenesis, which led the sulfate to undergo thermochemical sulfate reduction, a loss of permeability, and vertical dewatering.

Tang et al. (Contribution 15) conducted geochronological, geochemical, and apatite fission track thermochronology studies on sandstone from the Upper Triassic Dajianggang Formation at the northeastern margin of the North China Plate, and they conclude that the main source of the Dajianggang Formation was the Late Triassic magmatic arc of the Changchun–Yanji suture zone, possibly mixed with materials from the northern margin of the North China Craton in a convergent tectonic setting. They further point out that the orogenic process in the study area ceased during the Late Triassic period and that the remote effect of Pacific subduction did not impact the study area until 30 Ma.

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List of Contributions:

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