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Special Issue of the 10th Geochemistry Symposium

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CONTENTS/ İÇİNDEKİLER

PAMUKKALE ÜNİVERSİTESİ MÜHENDİSLİK BİLİMLERİ DERGİSİ
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PREFACE-Special Issue of the 10th Geochemistry Symposium

The National Geochemistry Symposium, first organized in 2004, has become a well-established scientific tradition held biennially and recognized as one of the leading forums in geochemistry. The symposium was hosted at TÜBİTAK BUTAL Bursa Facilities in 2004, 2006, and 2008; at Fırat University in 2010; Pamukkale University in 2012; Mersin University in 2014; Ankara University Earth Sciences Application and Research Center (YEBİM) in 2016; Karadeniz Technical University in 2018; and Istanbul Technical University in 2022. Over its twenty-year history, the event has expanded beyond its national framework to become an internationally attended scientific meeting. Originally focused on geochemistry, ore deposits, and petrology–petrogenesis studies, the symposium's thematic coverage has broadened over time in response to evolving scientific needs and growing interdisciplinary collaborations. Today, it encompasses a wide range of subjects, including hydrogeology, geothermal systems, industrial and energy raw materials, critical and technological elements, paleoclimate research, environmental and medical geology, and archaeometry. With this diversity, the symposium now serves as a comprehensive platform for sharing up-to-date scientific insights.

The 10th Geochemistry Symposium, held on 17–19 October 2024 and hosted by the Department of Geological Engineering at Aksaray University, successfully continued this distinguished tradition. More than 150 researchers participated, and 75 scientific contributions were presented. A noteworthy innovation characterized this event: for the first time in the symposium series' history, a dedicated Special Issue was prepared. A call for papers was issued to all symposium participants, and the submitted manuscripts underwent peer review in the Pamukkale University Journal of Engineering Sciences (PAJES). Within the scope of this Special Issue, the manuscripts submitted for consideration underwent a rigorous and independent peer-review process. As a result of this comprehensive evaluation, a total of 11 articles were deemed scientifically suitable for publication. Brief introductions to these accepted contributions are presented below.

On behalf of the Organizing Committee, we extend our sincere appreciation to the Editors-in-Chief of the *Pamukkale University Journal of Engineering Sciences (PAJES)*, Prof. Dr. Aydın Kızılkaya and Prof. Dr. Fatma Işık, as well as to the Special Issue Editors, for their invaluable efforts throughout the publication process. We also gratefully acknowledge the contributions of the reviewers, and the financial and institutional support provided by Aksaray University, TÜBİTAK, Ankara University YEBİM, and our sponsors. It is our hope that this Special Issue will make a meaningful contribution to the scientific field of geochemistry, inspire early-career researchers, and serve as a lasting scholarly resource for future symposia.

Hydrogeochemistry and origin of carbonated, sulfated, and saline geothermal waters, Central Anatolia, Türkiye

Afşin et al. investigate geothermal aquifers in Central Anatolia, characterized by carbonated, sulfated, and saline waters with temperatures ranging from 17.5 to 86 °C. These fluids are hosted primarily within marble and limestone units. The geothermal system is attributed to recent volcanic activity, granitic–syenitic intrusions, and radiogenic heat production. The authors suggest that salinization of isotopically meteoric waters results from halite dissolution and mixing with connate waters preserved at depth since the closure of the Tuz Gölü, central Kızılırmak, and Ulukışla basins. $\delta^{13}C$ data indicate that dissolved CO_2 derives from geogenic sources–marble and marine/lacustrine limestones-with a possible mantle contribution. $\delta^{34}S$ signatures further imply that sulfate originates from evaporitic units, volcanic lithologies, and/or carbonate formations. Apparent groundwater ages of 19–45 ka demonstrate that these fluids represent paleowaters recharged during the late Pleistocene to early Holocene.

Assessment of the suitability of clayey and sandy gypsum deposits from the Çankırı region (Türkiye) for plaster production

Taş et al. examined the potential use of gypsum from the Çankırı region as a direct end product in plaster manufacturing. The study used natural gypsum deposits containing minor amounts of clay and sand. Mineralogical (XRD and CRS), petrographic, and geochemical (XRF) analyses were first performed to characterize the raw material. Subsequently, mechanical tests-including uniaxial compressive and flexural strength measurements- were conducted to evaluate its suitability for plaster production without additional processing. The findings indicate that the natural clay-bearing gypsum in the Çankırı region meets the required standards and can be used directly in plaster applications. The study demonstrates that high-performance plaster can be produced without costly procedures such as material separation or the use of additives.

Spatial distribution and risk assessment of potential environmentally hazardous elements in coal: a case study of the Central Anatolia coalfields

Ünal-Kartal and Güllüdağ examined the spatial distribution of environmentally hazardous elements in the Ilgın and Karapınar lignite fields of Central Anatolia. By integrating geochemical data with Remote Sensing and GIS analyses, the study evaluated potential ecological and human health risks associated with coal mining. Sentinel-2–based land-use/land-cover classification revealed that mining zones lie in close proximity to agricultural and rangeland areas. The results show that Ni concentrations in Karapınar and As concentrations in Ilgın exceed global and upper continental crust averages. Spatial risk maps further indicate heightened vulnerability for agricultural lands and nearby rural settlements. Overall, the study provides critical scientific guidance for environmental monitoring, risk assessment, and sustainable management of mining-impacted regions.

PAMUKKALE ÜNİVERSİTESİ MÜHENDİSLİK BİLİMLERİ DERGİSİ
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Controlling factors of heavy metal distributions in granitoid-derived soils and their environmental risks

Güllü and Güllü investigated the extent to which the weathering degree of granitoids influences the distribution of heavy metals (HMs) in granitoid-derived soils in the northeastern part of Aksaray province. The authors collected samples from both the bedrock and the different soil horizons developed upon it, and performed whole-rock geochemical analyses using the Wavelength-Dispersive X-Ray Fluorescence (WD-XRF) method. Based on the analytical results, both weathering indices and environmental risk assessments were calculated, and their weighted spatial distributions were evaluated. The study emphasizes that although increasing alteration intensity in the granitoids shows a positive correlation with heavy metal enrichment, this enrichment does not indicate any significant HMs pollution. Overall, the findings reveal that the region is affected by low-level lithological contamination rather than anthropogenic pollution.

Alteration geology and geochemistry of Kesikköprü (Bala, Ankara) Fe-skarn deposit

Terzi and Yılmazer present a comprehensive mineralogical and geochemical characterization of the Kesikköprü Fe-skarn deposit and assess the broader metallogenic potential of the Kesikköprü granitoid. Integrated field, mineralogical (Raman, XRD, SEM-EDS), and whole-rock geochemical analyses reveal an endoskarn and four exoskarn subzones, with iron mineralization primarily concentrated in the epidote–garnet and epidote zones. Mass-balance calculations and geochemical transects indicate that skarn development was controlled by protolith composition, involving Ca-Fe-Mg-Mn-Si enrichment and Al–alkali depletion in granitoids, decarbonation coupled with Fe addition in marbles, and Fe–Ca influx with trace-element enrichments in mafic–ultramafic rocks. Comparison with globally recognized skarn-forming intrusions suggests that the Kesikköprü granitoid is genetically capable of generating not only Fe-skarns but also potential Cu- and partly Au- and Pb-Zn-bearing skarns, indicating diverse exploration prospects. Overall, the study clarifies geochemical evolution and ore localization within the Kesikköprü system while highlighting the region's broader metallogenic potential.

Differentiation of muscovites in igneous and metamorphic rocks according to their Raman spectra

Akçe and Kadıoğlu conducted a detailed Raman spectroscopic study to distinguish muscovite occurring in igneous and metamorphic rocks, demonstrating the technique's diagnostic potential for determining mineral origin. The investigation focused on muscovites from S-type granites of the Yozgat Intrusive Complex and quartz–mica schists of the Kırşehir Massif, allowing comparison across contrasting geological settings. Systematic shifts in Raman peak positions were documented, reflecting variations in pressure–temperature conditions; metamorphic muscovites typically display peak displacements associated with high pressures and elevated temperatures during deformation and recrystallization. The authors further argue that metamorphic stress fields promote preferred crystallographic orientation, thereby enhancing peak intensities, while spectral broadening corresponds to structural defects associated with foliation development. These results demonstrate that Raman spectral characteristics can effectively differentiate igneous from metamorphic muscovite and provide insights into the geological processes that shape them. Overall, the study underscores the value of Raman spectroscopy as a robust tool for provenance analysis and mineralogical characterization in complex crustal environments.

Mineralogical-Petrographic characteristics of garnet porphyroblasts (Ekinözü-Kahramanmaraş), determination of metamorphism conditions and gemstone potential

Ören and Koralay present an in-depth investigation of almandine-rich garnet porphyroblasts from the Ekinözü (Kahramanmaraş) region, revealing their distinctive mineralogical, petrographic, and geochemical characteristics. The study employs advanced analytical techniques, including Raman spectroscopy, XRD, EPMA, SEM, and ICP-MS, to reconstruct the metamorphic history and formation conditions of these garnets. Findings indicate that the crystals developed under greenschist-facies conditions, exhibiting abundant inclusions, pervasive fracturing, and notable geochemical signatures. Comprehensive REE distributions, trace-element patterns, and garnet–biotite thermometric data offer valuable insights into regional metamorphism and mineral evolution. In addition to their scientific relevance, the garnets display deep red coloration, vitreous luster and notable gemological potential. This special issue emphasizes their dual importance as key petrogenetic indicators and as aesthetically appealing semi-precious gemstones.

Petrogenesis and geochemical evolution of mafic dikes in the Kıratlı Region (Yüksekova Complex, SE Türkiye): Evidence for tholeiitic–alkaline transition during Neo-Tethyan evolution

Yazıcıoğlu and Üner present a comprehensive petrographic and geochemical analysis of mafic dikes intruding the Kıratlı ophiolite, part of the southeastern branch of the Neo-Tethys. The dikes, predominantly microgabbro and diabase, exhibit alteration features such as chloritization and sericitization. Whole-rock major, trace, and rare-earth element data indicate that the rocks are basaltic in composition and fall into two geochemically distinct groups: tholeiitic and alkaline. Tholeiitic samples display depleted REE patterns, Nb depletion, and Th enrichment, reflecting a supra-subduction zone mantle source. In contrast, alkaline samples exhibit LREE-enriched within-plate signatures indicative of low-degree partial melting and/or crustal contamination during extensional tectonics. These results reveal that the Kıratlı dikes record multi-stage magmatic activity linked to both subduction-related and post-subduction extensional processes, offering new insights into mantle dynamics and the geodynamic evolution of the southeastern Anatolian Ophiolite Belt during the final stages of Neo-Tethyan closure.

PAMUKKALE ÜNİVERSİTESİ MÜHENDİSLİK BİLİMLERİ DERGİSİ
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Mineral chemistry, thermodynamic evolution, and crystallization history of late miocene volcanic rocks around posof (Ardahan, Türkiye)

Cicerali et al. investigated the crystallization and emplacement conditions of the Late Miocene volcanic rocks exposed at the intersection of the Erzurum–Kars Plateau and the Eastern Pontides in Northeastern Anatolia using thermobarometric methods. The study revealed that these volcanic rocks consist of basalt, basaltic andesite, and andesite, and contain plagioclase, clinopyroxene, orthopyroxene, olivine, hornblende, and Fe-Ti oxide minerals. Magmatic disequilibrium textures such as zoning, sieve, and resorption structures were also identified. Thermobarometric calculations indicate that the magmas crystallized at temperatures of 880–1230 °C and pressures of 0.73–8.71 kbar. Overall, the findings suggest that the studied volcanic rocks crystallized at various crustal levels ranging from shallow to deeper depths (~2–32 km).

P-T evolution of subophiolitic amphibolites beneath the Kınık Ophiolite (İAESZ, Türkiye): Insights from garnet and amphibole chemistry

Aksoy investigates the metamorphic sole rocks underlying the Kınık Ophiolite within the İzmir–Ankara–Erzincan Suture Zone to elucidate the tectono-thermal evolution of the northern Neo-Tethys. The study combines field observations, petrography, mineral chemistry, and geothermobarometry applied to representative amphibolite samples. Garnet and amphibole compositions indicate basaltic protoliths, while P–T estimates of ~640–790 °C and ~4–5 kbar reflect medium- to upper-amphibolite facies metamorphism formed under high-temperature/low-pressure conditions characteristic of intra-oceanic subduction environments. These results refine the regional metamorphic framework of the IAESZ and provide new insights into the spatial variability and tectonic evolution of subophiolitic metamorphic soles.

Mineral chemistry of isotropic gabbro and plagiogranite from the Central Anatolian Ophiolites in the Derinkuyu (Nevşehir, Central Anatolia) region

Orhan and Akçe present an integrated petrographic and mineral-chemical study of isotropic gabbro and plagiogranite from the Central Anatolian Ophiolites in the Derinkuyu region, showing that plagiogranite intrudes the gabbro and incorporates mafic microgranular enclaves. Mineral chemistry reveals high-Mg diopside–augite clinopyroxenes, tschermakite–magnesio-hornblende amphiboles, and plagioclase compositions ranging from andesine to bytownite across the different units. Discrimination diagrams indicate an island arc–type supra-subduction zone affinity for the parental magma. Thermobarometry yields crystallization conditions of ~1199–1186 °C and 2.60–1.37 kbar for clinopyroxene and ~864–790 °C and 1.95–1.09 kbar for amphibole, suggesting progressive fractional crystallization at shallow crustal levels (9.2–3.9 km). Overall, the study refines the petrogenesis and high-level SSZ magmatic evolution of the Derinkuyu ophiolitic suite within the Central Anatolian Crystalline Complex.