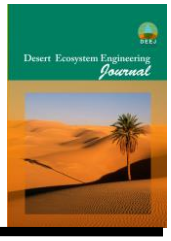
DEEJ (2023) 11 (36) 83-101

University of Kashan

Desert Ecosystem Engineering Journal

Journal homepage: http://deej.kashanu.ac.ir



Geochemistry of Sabzevar Playa Sediments: Implications for Tectonic setting and Paleoclimate changes

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Received: 06/09/2022 Accepted: 30/01/2023

Extended Abstract

Introduction: Playa is known as the dominant landform in arid and semi-arid regions and some cases, it is the only evidence of past environmental conditions in semi-arid regions. Geochemical methods are used to study geochemical processes, tectonics, and the origin of playa sediments. The most important aspects of origin studies are the determination of source rocks, relief, climate, tectonic setting, transport history, and diagenetic changes. The Quaternary period was characterized by drastic changes in climatic conditions worldwide so the escalation of eolian processes, desert formation, and drying of lakes is attributed to this period. Playa is a region with negative water balance for more than half a year as well as capillary properties close to the surface and sediments. In some cases, playa sediments are the only evidence of past environmental conditions in arid and semi-arid regions.

Materials and methods: The Sabzevar playa, stretching in an area of approximately 120 km, is one of the most elongated depressions in Khorasan Razavi province in northeastern Iran covering an area of 2648 km2 and located between 35°55' – 36°25' north latitude and 56°15' – 57°45' east longitude. Sabzevar playa is often classified along with Great Kavir and its surrounding playas (e.g. Damghan Kavir, Bajestan playa, Haj Aligholi Kavir) under the name of the “Dasht-e Kavir” basin. The primary lake probably closed during the Lower Pleistocene and the surrounding faults like the Mureh fault at a distance of 4 km are attributed to Upper Neogene. This is consistent with the trench of the Mureh River in the southwest playa, which was formed during the Middle Pleistocene. The geological nature of the playa includes alluvial and evaporation sediments belonging to the Quaternary period. Windborne dunes, tertiary igneous rocks, and Cretaceous carbonates (dolomite and limestone) are mainly found in the neighboring mountain flanks. Some areas in the periphery of Sabzevar Playa also contain ophiolite sequences called Sabzevar ophiolites. Intrusive and volcanic units are mainly found around the northern and eastern parts of the Playa. Furthermore, carbonates and detrital sedimentary units containing conglomerates and sandstone are scattered with abundant outcrops. Noteworthy, near the western half of the playa, there is a metamorphic complex with pre-Jurassic sedimentary sequences. These metamorphisms are characterized by varying degrees of metamorphism from green-schist to amphibolite. One hundred sixty air-dried powder samples were examined to identify both bulk and clay mineralogy using the X-ray diffraction (XRD) at the central laboratory of the Ferdowsi University of Mashhad and Razi Applied Science Foundation in Tehran. The major concentrations of oxide and trace elements were determined by X-ray Fluorescence (XRF) according to the procedure explained by Abdi et al., (2018). As major representatives of environmental changes (wet/dry periods), the elemental ratios were calculated at surface and depth.

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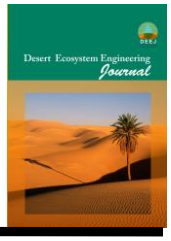

Results: Based on the mineralogical results by X-ray diffraction (XRD) and scanning electron microscopy (SEM-EDS) silica oxide, clay, carbonate, and evaporite minerals are the most abundant minerals identified in the sediments of Sabzevar playa (Table 1). The results of the X-ray fluorescence (XRF) show that silicon oxide (SiO_2) with the highest abundance (between 39.8 and 45.5% by weight) among the main oxides identified in the sediments. The amount of L.O.I (Loss on ignition) in these samples also includes between 1.8 and 16.9 percent by weight of sediments. Minor elements in these samples also include as Ba Ce, Co, Cr, Cu, Nb, Ni, Pb, Rb, Sr, V, Y, Zr, Zn, and Cl.

Keywords: Geochemistry, Modern Sediment, Provenance, Sabzevar Playa, Weathering Index.

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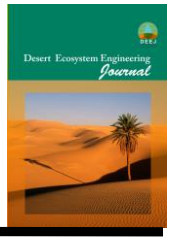

Table 1: Amounts of minerals forming sediments by XRD* method

No#	247	210	207	277	290	283	294	313	283
Depth (cm)	90-100	0-10	0-10	0-10	90-100	0-10	0-10	0-10	90-100
Illite	-	-	-	-	6.32	-	11.8	-	-
Halite	2.60	19.20	-	24.89	13.10	30.9	5.8	-	39.45
Quartz	51.90	34.04	37.80	26.75	26.23	33.9	40.9	41.7	32.41
Silvite	-	-	1.04	-	-	-	-	-	-
Nontronite	-	-	3.86	8.44	-	-	-	-	2.13
Palygorskite	-	-	4.94	8.44	5.30	-	5.3	-	2.5
Montmorillonite	5.60	3.30	3.13	-	7.55	-	-	-	-
Hedenbergite	-	-	-	-	6.00	-	-	-	-
Eastonite	4.10	-	-	-	-	-	-	-	-
Calcite	20.80	12.31	22.60	21.81	13.60	22.12	25.8	40.8	23.51
Sepiolite	-	-	-	-	5.21	-	-	-	-
Zeolite	0.50	3.10	-	-	-	12	-	-	-
Albite	14.00	11.10	7.86	-	-	-	6	17.5	-
Cristobalite	-	-	17.76	-	-	-	-	-	-
Dolomite	-	2.20	-	7.41	-	-	-	-	-
Magnetite	-	3.40	-	-	-	-	-	-	-
Halloysite	-	7.05	-	-	7.85	-	-	-	-
Anhydrite	-	4.30	-	-	8.40	-	-	-	-

*: all estimated values are approximate

Discussion and Conclusion: Based on the Fe2O3/K2O oxide values and the presence of clay minerals, Sabzevar playa sediments are equivalent to wackes according to Herron's classification (Herron, 1988). The enriched amounts of CaO, MgO, and Na2O oxides compared to the values of the upper continental crust and the negative trend of Na2O versus SiO2 and Al2O3 are caused by carbonate minerals such as dolomite, calcite, and the presence of halite minerals in the playa sedimentation environment. High amounts of Fe2O3 oxide in the sediments are due to the presence of magnetite. The positive relationship between SiO2 and Al2O3, the SiO2/Al2O3 ratio, and the depletion of these two oxides are caused by the relatively small amounts of siliceous sediments compared to other playa sediments and clay minerals. The enriched amounts of Na2O, along with the amounts of Al2O3 and K2O3, are due to the presence of feldspars and clay minerals. Low values of TiO2 can be caused by their derivation from intermediate rocks. The enrichment of Sr element can be due to the replacement of this element with K in potassium minerals and replacement with Ca in calcium minerals. Based on the positive trend of TiO_2 compared to Zr and Al2O3 and the ratios of minor elements such as Cr/V and Y/Ni, Sabzevar playa sediments are of intermediate to mafic igneous origin similar to ophiolites. According to the lithology around Sabzevar playa and the geochemical evidence, the Sabzevar ophiolite series in the northeast, and the metamorphic complex in the west of the playa have played a major role in providing the sediments of Sabzevar playa. Geochemical data of these sediments in the source area show evidence of a dry climate. These sediments have been left in an active tectonic setting such as oceanic to continental magmatic arcs, which is consistent with other results and the ophiolitic origin of the region.

Keywords: Geochemistry, Modern sediment, Provenance, Sabzevar playa, weathering index.