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Importance of hydrogeochemical processes in the coastal wetlands: A case study from Edremit-Dalyan coastal wetland, Balıkesir-Turkey

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ABSTRACT

Investigating the hydrogeochemical properties of wetlands allow us to protect them in a sustainable fashion in global scale. Edremit-Dalyan coastal wetland (EDCW) is located in southern part of Biga Peninsula (Mount Ida) which is the most important eco-tourism center in Turkey. Water sampling was done from the hydrologic basin of coastal wetland that consists of a geothermal site, ore deposits area, treatment facility area and olive tree breeding area. EC values of wetland vary between 440 and 2190 μS/cm and water type shows a shift from $CaHCO_3$ to $NaClSO_4$. Al, As, Cd, Cu, Fe, Pb and Zn concentrations exceed the tolerance limits in wetland area probably due to ore deposits around the Edremit Plain. Concentrations of As are high in wetland area exceeding both aquatic life and drinking water As standards of 10 μg/L by as much as 3 times are observed. The dominant As species is As (III). For the living organisms, this situation can be dangerous. Oxygen-18 and deuterium composition of the samples between −7.18 and −6.13‰, and between −42.6 and −34.4‰, respectively in the study area and all the waters are of meteoric origin. Oxygen-18 enrichment can be observed around Derman and coastal zone due to the geothermal activity and evaporation, respectively.

1. Introduction

Wetlands are sensitive and important ecosystems especially for the fresh water part of the hydrologic water cycle. However, in general, wetlands are those areas where water is the primary factor controlling the environment and the associated habitats (Silva et al., 2007). To solve the water rock interactions, discharge/recharge areas of wetlands should be investigated. The water chemistry of wetlands is primarily a result of geologic setting, water balance, and quality of inflowing water, type of soils and vegetation, and human activity within or near the wetland (Carter, 1996). Water quality is linked to lithology, urbanization, and distance to the sea/industrial/agricultural area in the wetlands. A multidisciplinary approach is needed to study of the water quality of wetlands. Hydrogeochemical tools help to reveal groundwater properties, surface-groundwater interactions.

Salinization of ground/surface water is one of the frequently observed natural contamination types in the coastal wetlands of western Turkey (Somay and Filiz, 2003; Somay et al., 2008; Somay and Gemici, 2009, 2012). The coastal zones in most countries have been subjected to severe and increasing pressures as a result of conflicting uses such as rapid urbanization, environmental pollution, tourism development, and other coastal activities as in Gulf of Edremit (Irtem et al., 2005). This gulf (Balikesir) and its coastal wetland are located in the southern part of Biga Peninsula, NW Turkey (Fig. 1). Edremit-Dalyan coastal wetland (EDCW) which is the most important eco-tourism center of Turkey is located to the south of Mount Ida. Mount Ida is considered as one of the most valuable floristic areas of Turkey. Due to these reasons, towards to Mount Ida there are many touristic hotels near the EDCW. Edremit region is famous for its olive cultivation as well as ore deposits. Currently several active metal mines are operating in Biga Peninsula, though some of them have intermittent production (Yiğit, 2012). Various investigations about ore deposits in and around the study area were done by several researchers including (çolakoğlu, 2000; Yiğit, 2006, 2009; Yılmaz, 2007; Oyman, 2010; Akiska et al., 2013). Epithermal Au–Ag deposits including high-(HS), low-(LS) and intermediate-sulfidation (IS) styles, porphyry Au–Cu–Mo and base-metal skarn systems are economically the most important ones (Yiğit, 2012). On the other hand, there is an important geothermal area in Edremit distinct. The Edremit-Derman geothermal field, with discharge temperatures ranging from 42 to 62 °C, is utilized for space heating and geochemical

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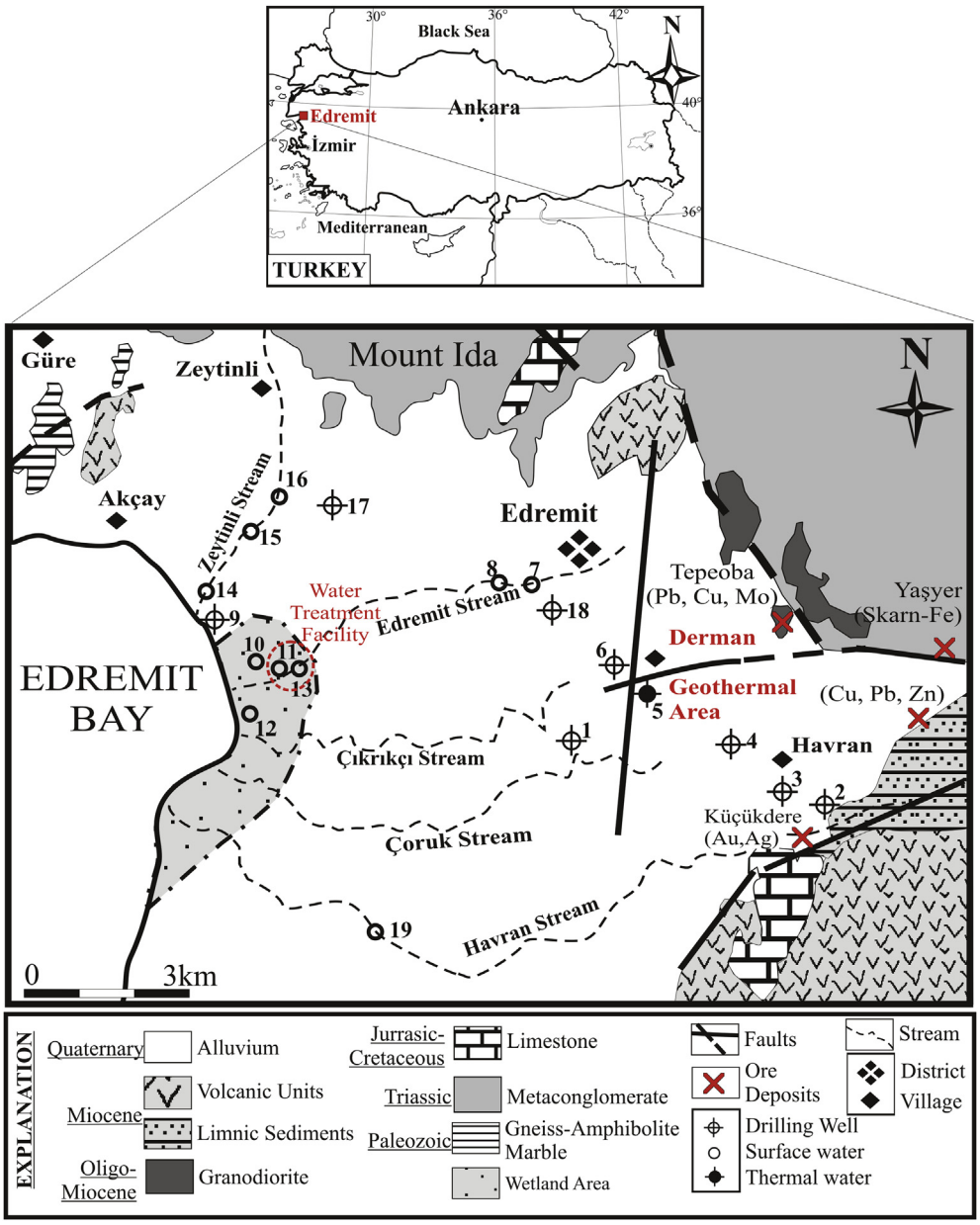

Fig. 1. Location, Geology (modified from Demirel et al., 2004) and Sample Map of the study area.

analyses revealed that Na + K–SO_4 (>40 °C), Ca–HCO_3 (<30 °C) and Ca–SO_4 (30–40 °C) waters occur (Avşar et al., 2013). In the area, there is no re-injection well to remove the thermal water waste.

EDCW area is about 60 ha (Fig. 1). Swamps are the most dominant wetland type. This area is important for the routes of the migratory birds and this is an endangered area. As the community's tourism industry and housing needs grow, the wetlands are being filled with new constructions (EWC, 2015).

According to Efe et al. (2015), the main human-caused problems in the area are as follows: uncontrolled and unplanned settlement within the natural borders of the EDCW, dumping waste and rubble on alluvium which act as an aquifer, physical and chemical pollution in the rivers cutting across the area, waste water discharge from olive oil factories into the wetland, uncontrolled waste inputs, wastes of geothermal waters that are not re-injected, polluting elements from the solid waste storage area of Edremit, and problems caused by the highway. There is a Water Treatment Facility in the center of the wetland area, which has been dumping excessive amount of untreated waste into the sea each day and shut down in 2001. And also, used geothermal waters from local hotels are being drained through a nearby canal into the sea, causing unpleasant sight and odor in the area (EWC, 2015).

This area was selected because EWC which is a non-profit organization consisting of Minneapolis Collage of Art and Design and the other partners from Turkey, want to build a “Wetland Park” and “Water Institute” for educational use, and to promote a sustainable environment in Edremit region. The overall objective of this hydrogeochemical and isotopic study carried out in the area is to investigate the water-rock interaction of the EDCW and its vicinity, to sort out the origin of waters and to estimate the natural and anthropogenic levels of contamination.

2. Material and methods

A total of 19 water samples were collected from the wetland streams, wells and one thermal spring in April 2013 (Fig. 1; Table 1).