Arsenic (As) is a proven carcinogen that causes internal organ and skin cancers when it enters the body through oral or dermal route. Throughout the world, many countries including Bangladesh, Taiwan, India, Chile, Argentina and USA are experiencing geogenic arsenic problems in groundwaters (Bhattacharya et al., 2012). Similar As-related problems have emerged in Turkey in recent years and difficulties in drinking water supply were experienced in some residential areas (Gündüz et al., 2010a, Baba & Sözbilir, 2012). The Simav Plain is one of those areas with above standard As concentrations in surface and subsurface waters (Gündüz et al., 2010b). This study presents the results of the hydrogeochemical assessments of subsurface waters in the region as well as the sources of As and its dominant species.

1 INTRODUCTION

Arsenic (As) is a proven carcinogen that causes internal organ and skin cancers when it enters the body through oral or dermal route. Throughout the world, many countries including Bangladesh, Taiwan, India, Chile, Argentina and USA are experiencing geogenic arsenic problems in groundwaters (Bhattacharya et al., 2012). Similar As-related problems have emerged in Turkey in recent years and difficulties in drinking water supply were experienced in some residential areas (Gündüz et al., 2010a, Baba & Sözbilir, 2012). The Simav Plain is one of those areas with above standard As concentrations in surface and subsurface waters (Gündüz et al., 2010b). This study presents the results of the hydrogeochemical assessments of subsurface waters in the region as well as the sources of As and its dominant species.

2 THE STUDY AREA

The Simav Graben Area is located in west-central Anatolia and is a semi-closed basin that contained the Simav Lake (Fig. 1) which was drained in the 1960s and was converted to agricultural land. It is a E–W trending Pliocene to Quaternary asymmetric depression that was developed on the older NE–SW trending Miocene basins in Western Anatolia (Seyitoğlu, 1997). The graben is bounded from the south by an active oblique-slip normal Simav fault. The graben fill is composed of semi-lithified boulder conglomerate and sandstone.

The Simav geothermal field that is situated to the north of the Simav district center has three geothermal outflows (Fig. 1) with reservoir temperatures reaching as high as 170 °C. (Gündüz et al., 2010b).

3 METHODS

Research boreholes were drilled in 21 locations to a total depth of 846 m and 157 core samples were taken to determine the depth-integrated geochemical status of the plain. Elemental analysis of these core samples were conducted by acid extraction followed by detection using ICP-MS. The boreholes were then converted to groundwater monitoring wells by locating filters at elevations that correspond to high core arsenic levels. Samples were later collected from these 21 subsurface water monitoring boreholes as well as 7 other wells that were previously drilled in the area. In addition, samples were also taken from 3 geothermal waters in three different sampling periods during the study. All water sam-
ples were then analyzed for total arsenic, arsenite, arsenate and organic arsenic species (DMA, MMA) with ICP-MS and LC-ICP-MS tandem techniques.

4 RESULTS AND DISCUSSIONS

Based on previous studies, the metamorphic rocks of the region have strong iron and sulfide oxidation due to hydrothermal alteration and arsenic is typically observed in sulfide oxide sediments transported from these rocks that create the Quaternary alluvium sediments (Gündüz et al, 2010b). A comprehensive study was conducted on the sediments and groundwaters of the plain to determine the vertical layering of arsenic containing sediments. Geochemical analysis conducted in 21 boreholes revealed that the alluvial sediments of the plain had arsenic levels that are 2 to 3 orders of magnitude higher than world average value. The 157 core samples taken from 5-18 different depths had maximum, minimum and average arsenic values of 833.9 ppm, 7.1 ppm and 48.99 ppm, respectively, which are clearly higher than the world average value of 1.5 ppm. Spatial distribution of core sample arsenic values are given in Figure 1.

![Figure 1: Comprehensive study conducted on the sediments and groundwaters of the plain to determine the vertical layering of arsenic containing sediments.](image)

5 CONCLUSIONS

Total arsenic values were found to be several orders of magnitude higher than the standard value of 10 ppb in Simav Plain. This result is strongly supported by the presence of elevated values of arsenic in core samples. As groundwater in the plain was mostly under reducing conditions arsenite was the dominant species and reached to about 1 mg/L, indicating significant arsenic pollution in the region. These results indicate an eminent risk for direct human consumption of groundwater and further necessitate the use of arsenic removal technologies for all residential areas supplying their drinking water from the plain.

REFERENCES


