6.7 3D VELOCITY STRUCTURE AND FLUID FLOWS INFERRED FROM THE MICROSEISMIC EVENTS IN THE GEOTHERMAL FIELD, TURKEY

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ABSTRACT

Geothermal energy, being a renewable energy source, holds significant potential, particularly in our country. Once exploration methods are employed to identify suitable locations for production wells and the optimal placement of geothermal power plants, there is often a lack of further studies focused on reservoir monitoring or reservoir management within the field. However, it is crucial to implement microseismic monitoring as a customary practice to ensure the sustainability of geothermal reservoirs. This method has been extensively applied worldwide in various geothermal projects. Nonetheless, the first comprehensive application of this method in an industrial context in our country was carried out at the Manisa Geothermal site, supported by TÜBİTAK (1501 TÜBİTAK-TEYDEP Project no: 3200756). Initially, we selected seven borehole sensors strategically positioned around production and injection wells in the geothermal field based on noise analysis results. Continuous data records were analyzed to detect and locate microseismic events, calculate their magnitudes, and determine focal mechanism solutions for assessing stress changes. These events occurred underground during the operations of re-injection, production wells, and overall geothermal activities. Finally, 3D seismic tomography studies were conducted to determine the velocity structure of the field, the mapping of the current reservoir conditions, and the movement of water within the subsurface.

KEY WORDS: Geothermal Energy, Microseismic Monitoring, Reservoir Monitoring, Induced Seismicity.

INTRODUCTION

Renewable energy sources have garnered global significance due to the depletion of fossil fuels and the escalating demand for energy. Our country holds the highest potential with regards to geothermal resources. Geothermal energy is a renewable and environmentally friendly form of energy derived from natural heat sources situated deep within the Earth's crust. The production of geothermal energy involves the extraction of subterranean water or steam, which is subjected to high temperature and pressure, for the purpose of energy generation. During these operations, microseismic events occur, which are characterized by low energy, high frequency, small amplitude, and rapid attenuation.

The microseismic method entails the precise measurement of seismic wave characteristics, including velocity, frequency, and shape. The standardized implementation of this method is