



# THE INVESTIGATION OF KIŞLA DOME STRUCTURE IN SOUTHERN PART OF ISPARTA ANGLE, SW TURKEY

Züheyr Kamacı<sup>1</sup>, Nevzat Özgür<sup>1</sup>, Fuzuli Yağmurlu<sup>1</sup>, Coşkun Sarı<sup>2</sup>, Murat Şentürk<sup>1</sup>, and Canan Çiftçi<sup>1</sup>

(<sup>1</sup>) Süleyman Demirel University, Research and Application Centre for Geothermal Energy, Groundwater and Mineral Resources, Isparta, Turkey  
(<sup>2</sup>) Dokuz Eylül University, Faculty of Engineering, Izmir, Turkey

## ABSTRACT

The Isparta Angle is one of the most important geographical structures in SW Anatolia, Turkey developed by bending of Taurides in northern part of Antalya bay. The Edirdir-Kovada graben, which extends through N-S direction and diminishes towards the S, divides Isparta Angle into two equal sections. Mesozoic carbonate sequence forming the western part of Isparta Angle is called 'Akseki-Anamas autochthonous'. The autochthonous rock sequence forming the western part of Isparta Angle is called 'Beydağları autochthonous'. The structural entities within the Isparta Angle extends parallel or semi-parallel to main N-S trending lines. Although a great number of the folds located in the eastern part of Isparta Angle are generally NW-SE extensions, the folds located in the western part are mainly NE-SW extensions. However, the axis of folds in the northern part of Isparta Angle dominantly exhibit NNW, NNE and EW trendings. Due to pushing effects of E side of Isparta Angle towards W side until Early Pliocene along N-W Aksu thrust, multi-stage thrusts parallel to Aksu thrust are formed, especially in E side.

The geological structure known as Kışla dome is located on the N-S extension alkaline Afyon-Antalya volcanic trend. The volcanics consisting of trachyandesites, trachytes, phonolithes and lamproites formed mainly by sub-volcanic dykes, domes and pyroclastic tuffs extend along N-S alkaline volcanic trend within the Isparta Angle. The most important distinguishing formations of the Kışla Dome are circular geometric structures, which are observed by satellite images and sophisticated radial drainage systems. The Kışla Dome is formed by the folding of Triassic and Tertiary formations in the area, and is surrounded by the Aksu thrust from E. The gravity and magnetic data measured on the dome structure range between -60 and -70 mgal and 46000 and 47150 nT, respectively. The findings showing that no distinguishable anomalies are present on Kışla dome based on magnetic, gravity and heat flow measurements further indicate that this structure is not formed after magmatic activities and is probably formed after tectonic activities. The E-W thrusts and associated folding systems, which are developed between Middle Eocene and Early Miocene rocks on the north of Kışla Dome, show that the region was under the influence of N-S compressions during the Middle to Late Miocene. On the other hand, currently active N-W Aksu thrust resulted in the formation of Kışla dome.

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## INTRODUCTION

Tauride belt in southern Turkey comprises mainly a stack of imbricated, allochthonous nappes, overlying the autochthonous Tauride carbonate axes. These carbonate axes forms a north pointing cusp named as the Isparta Angle in southwestern Turkey. Geology and evolution of the Isparta Angle have been investigated by many researchers especially since 1960s (Güncü, 1977; Yalçınkaya, 1989; Şenel, 1984; Poisson ve diğ., 2003). Fast developments in satellite images have given rise to arising of new images having high resolutions. Using the satellite images, a dome-like structure nearly in 10 km diameter was determined around Kışla area, 20 km south of Isparta (Fig. 1; Uysal 2004). On the other hand, this dome-like structure take place in the N-S trending Afyon-Antalya volcanic province of Yağmurlu et al (1997). Although having carried out geophysical studies using especially gravity and magnetic methods in the Isparta angle (Ateş and Kearey, 1995; Bilim and Ateş, 1999; Bilim and Ateş, 2004), a dome-like structure was determined first time in this study.

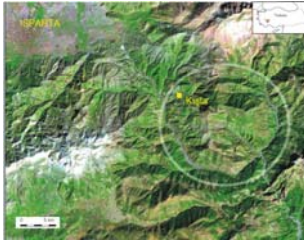


Figure 1. Satellite image of Kışla dome on the Landsat 7-4-1 (1985 August)

## GEOLOGICAL SETTING

The study area is located 20 km south of Isparta and covers an area of 80 km<sup>2</sup>. Geological map of the study area in 1/10 000 scale, geological cross sections (Fig.2) and generalized tectono-stratigraphic columnar section (Fig.3) were prepared in this study. The rock units are divided into two groups as autochthonous- paraautochthonous and allochthonous units. Autochthonous-paraautochthonous units are Davras formation (Early-Late Jurassic carbonate rocks), Beydağları formation (Early-Late Cretaceous carbonate rocks), Yazır limestone (Aquitian reefal limestone), Burdigalian Ağlasun formation including flysch type deposits. Allochthonous units are Antalya nappes and Kaykay formation (Eocene-Middle Triassic thin bedded cherts and limestones) and ophiolitic complex. Eocene Kaykay formation including flysch type deposits rest tectonically on the Aquitanian and Burdigalian units (Fig. 2,3). All the units are in places intruded by trachytic and lamprophyric dykes.

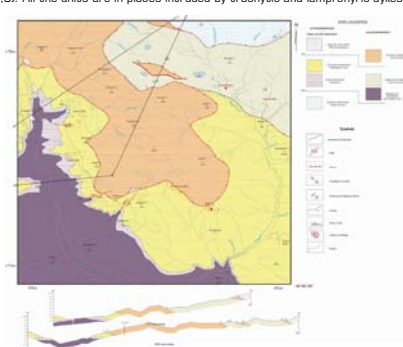


Figure 2. Geological map of the study area

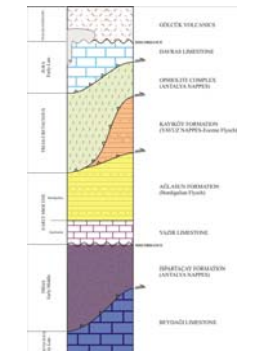


Figure 3. Generalized tectono-stratigraphic section of the study area.

## PETROGRAPHY AND GEOCHEMISTRY

Magmatic rocks outcropping around the Kışla dome were investigated in terms of geochemical and petrographic features. Volcanic rocks consist mainly of corroded plagioclase, sanidine, amphibole, pyroxene crystals (Fig.4). In the SiO<sub>2</sub> vs. Na<sub>2</sub>O + K<sub>2</sub>O (TAS) diagram, volcanic rocks plot in the trachyte area (Fig. 5). Syntectonic anclaves, plutonic equivalent of the trachytes, are observed in the volcanic rocks. Therefore, it is thought that syntectonic intrusion occurs below the Kışla dome.

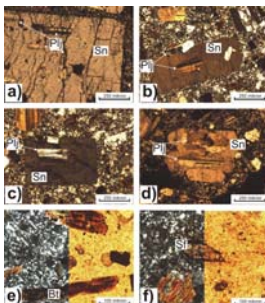


Figure 4. In the trachytes outcropping around the Kışla dome a) plagioclase crystals occurring in parallel to margin of sanidine, b,c,d) plagioclase crystals mantled by sanidine, e) biotite crystals corroded and crowded with opaque reaction products, f) amphibole and sphene crystals corroded along crystal margins. Plj: plagioclase, Sn: sanidine, Bt: biotite, Sf: sphene.

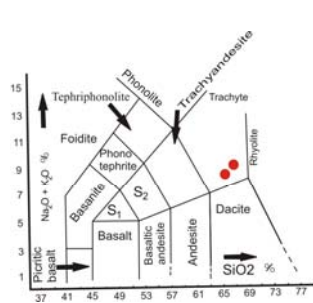


Figure 5. Plot of the volcanic rocks on the SiO<sub>2</sub> vs. Na<sub>2</sub>O+K<sub>2</sub>O diagram (TAS diagram from Le Maitre, 1984).

## GEOPHYSICAL INVESTIGATIONS

Kışla Domu (Isparta) and surrounding area were investigated for the points of view as geology, tectonics and geophysics. The field studies were carried out between July-August 2007 and numbers of 1761 total magnetic data were collected by Scintrex ENVI MagGradiometer in Kadılar Mahallesi and its vicinity area.

At first, M25 and N25 gravity and aeromagnetic sheets (scaled 1/100 000 and prepared by MTA) were digitized with 1 km data interval. These data were evaluated to determine general tectonic structure of the field by using data processing techniques as filtering, analytical continuations, trend analysis and second derivatives. The gravity data measured on the dome structure range between -60 and -70 mgal (Fig.6).

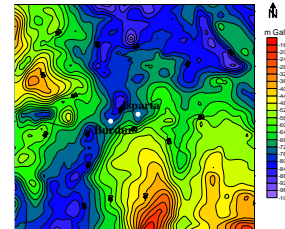


Figure 6. Bouguer gravity anomaly map (counter interval 5 mGal)

The total magnetic field data which were collected in Kadılar Mahallesi were gridded with 25 m. data interval and total magnetic field anomaly map was plotted (Fig.7). Gridded magnetic data were evaluated by using data processing techniques as filtering, analytical continuations, trend analysis and second derivatives.

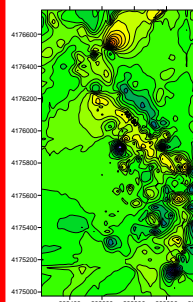


Figure 7. Total Magnetic Anomaly Map (Kadılar Mahallesi) (Contours in nT)

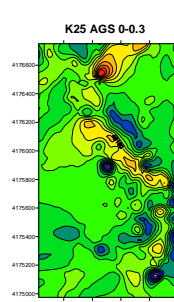


Figure 8. Low pass filtering anomaly map (cut-off frequency 0.0-0.30) (grid interval 25 m., contours in nT)

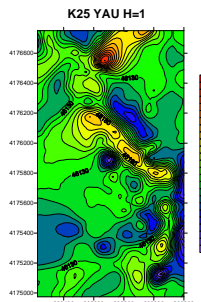


Figure 9. Upward Analytical Continuation anomaly map (H=1 grid interval, grid interval 25 m., contours in nT)

As shown Fig.7., the main anomaly structure is trending from SE to NW direction. The same indications are clearly seeing on the low pass filtering and upward analytical continuation anomaly maps (Fig 8 and Fig 9). The maximum data values are located in Kadılar Mahallesi, north of the magnetic anomaly map. This indicates to existing an uplifting structure.

## CONCLUSIONS

In this study, Kışla Domu (Isparta) and surrounding area were investigated for the points of view as geology, tectonics and geophysics. The study area comprises autochthonous-paraautochthonous (Early-Late Jurassic carbonate rocks of Davras formation, Aquitanian reefal limestone of Yazır limestone, Burdigalian Ağlasun formation including flysch type deposits) and allochthonous units (Antalya nappes and Kaykay formation) are observed in the study area. All the units are in places intruded by trachytic and lamprophyric dykes. The gravity and magnetic data measured on the dome structure range between -60 and -70 mgal and 46000 and 47150 nT, respectively.

The findings showing that no distinguishable anomalies are present on Kışla dome based on magnetic, gravity and heat flow measurements further indicate that this structure is not formed after magmatic activities and is probably formed after tectonic activities.

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