

APPLICATION OF SATELLITE PHOTOGRAPHS IN A MORPHOTECTONIC STUDY OF THE CENTRAL ALBORZ, IRAN

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ABSTRACT

This paper introduces a study of morphotectonic structure in the Central Alborz Basin, Mazandaran province of Iran (about 1200 square kilometer), using Russian KFA-1000 satellite photography and sequential air photographs. The KFA-1000 metric camera has better ground resolution than SPOT and LANDSAT for the whole of the study area. Results are provided from one pair of 30×30 cm. photos, which provided easy interpretation and better results than other data. Areas identified from these images as being of significance were examined in greater detail through the use of aerial photographs (at scales of 1:5000, 1:10000 and 1:60000 were available).

INTRODUCTION

Remote sensing control is an effective tool for mapping of geology, geomorphology and vegetation, and is particularly useful in inaccessible mountain regions, where land based investigation is difficult (Eiubov et al., 1988). This study is concerned with the utilization of KFA-1000 satellite photography for the detection of morphotectonic features in the Lar Dam basin. About a decade of information from LANDSAT and SPOT satellites is generally considered to be the leading non-military remote sensing information. The efficiency of both systems in terms of operation and reliability has not yet been achieved by any other system. The political changes in the former Soviet Union, have recently made it possible to access a photographic satellite system which was originally designed for military purposes. This has now become a serious competitor to LANDSAT and SPOT at least so far as geometric resolution is concerned.

TECTONIC STRUCTURE OF THE AREA

The Alborz Range constitutes a broad arch which forms the southern border of the vast depression of the Caspian Sea. The western part of the range shows structural axes trending NW-SE, roughly parallel to the northern part of the Zagros main thrust, to the Zanjan fault and to the structural alignments of the little and Great Caucasus. On the other hand, the eastern part of the Alborz Range is characterised by structural axes trending approximately NE-SW, parallel to the Great Kavir Fault (Central Iran). These two different structural trends just meet in the Central Alborz Range, which thus assumes a critical position in the framework of the range. It is of interest that it is precisely in this zone of convergence of two different alignments that the Quaternary volcano of Damavand has been formed (Figure1).

CHARACTERISTICS OF RUSSIAN SATELLITE PHOTOGRAPHY

The KFA-1000 camera system acquires colour spectrozonal photography from an average height of 270 kilometers with an average scale of 1:270,000. The frame size is 30x30 cm., covering an area of 6400 Km² with 60% longitudinal overlap of photographs. The ground resolution of this photography is 5 to 10 m., and it has spectral ranges of 570-680nm and 680-810nm. The camera number, focal length and exposure number appear in each frame as well (Table 1), (Sollner, 1993).

Table 1. Technical data of high-resolution satellite systems

Type	Altitude (km)	Resolution/m	Spectral reso	Format	Dimension of Scance (km)
SPOT	830	(10/pix)(20/gr.res.	Panch		60×60
LANDSAT 4&5	790	79/gr.res	Mss		185×185
KFA-1000	220-350	5-10	CIR	30×30cm	66×66 105×105

TECTONIC STRUCTURE OF THE STUDY AREA FROM KFA-1000

The structure of this region is characterized by several broad, very regular structures extending in an *E-W* or *ESE-WNW* direction from the slopes of Damavand Volcano as far as the course of the upper Lar where this river, flows southward. A brief description of the principal structures identified from KFA-1000 data will be given below, from the north southwards (Figure 2).

Sefid-Ab Overthrust

This overthrust extends from the southern slopes of Kuh-e-Namak kusar along the Sefid-Ab valley as far as the upper Lar valley, where it joins with the Garmabdar overthrust. It has a *WNW-ESE* trend and a somewhat north-sloping fault plane. The northern block, whose base is constituted by the plastic Shemshak formation, moved over this fault, bending slightly in an anticline. North of the Dombak-Kuh and between the Alarm and Sefid-Ab valleys, there is a system of elongate dislodged slices predominantly consisting of Jurassic and Cretaceous limestones. The Sefid-Ab overthrust may have originated as a fracture formed at high angle to the bedding across one limb of a slightly folded anticline and by movement over strata of an adjacent syncline; in this instance, the dislodged slice would represent the stretched southern flank of the fold. *Piazak overthrust*, is a minor dislocation which diverges from the Garmabdar overthrust at the Lar - Sefid-Ab confluence, near the Chehel-Khaneh of the upper Lar, joining the Sefid-Ab thrust, at the Alarm-Bozorg, after a *WNW-ESE* trend. The fault plane is subhorizontal or slightly inclined northward. The tectonic movements caused the Jurassic limestone of the Lar formation out cropping to the north of the fault to overly the south-alligned Eocene tuffs of the Karaj formation.

Chehel Cheshmeh-Tiz Kuh syncline

Crosses the whole of the Lar valley from Takht-e-Shekarak Kuh to Polour, extending over an area more than 30 km long and exceding 6-7 km in breadth. It is a mostly symmetrical syncline with on *WNW-ESE* trending axis and very steep flank. Eocene or Upper Cretaceous sediments are exposed in the core of the structure, whereas the flanks are, comprised of Jurassic sediments. The uniformity of this structure is interrupted along the northern slope of Kamar-Dasht by a fault with a steeply south-dipping plane, which cuts the southern flank of the syncline, that has moved relatively up over the younger core. From the geometric point of view, this is a reverse fault, whose northward movement contrasts with the trends of the other structure occuring in the neighbouring zones. Assereto (1966) suggested that this dislocation is not due to any south-north stress, but it is rather related to the collapse of the core of the Chehel-Cheshmeh syncline, as a consequence of the southward movement of the Sefid-Ab thrust which caused an increasing lack of space in the core of the fold. *Polour Anticline*: to the south of the Chehel-Cheshmeh Syncline the Liassic beds form a wide anticline, trending *WNW-ESE*. This anticline is mostly symmetrical and has a vertical plane; only south of Chehel-Cheshmeh the southern flank dips more steeply and the axial plane presents a slight southward trend. West of Chehel-Cheshmeh the vast Quaternary covering conceals the prolongation of this structure. Assereto (1966), on account of progressive stretching and breaking of the southern flank, suggested that this anticline probably produced the Khoshk-e-Rud fault to the west.

Pahnak-Kuh Synclin

Runs from Fileh-Zamin to Haraz valley, extending eastwards out of the region mapped, as far as Mianrud- Kuh. In it's eastern part from the Haraz to Pahnak-Kuh, this syncline exhibits an extremely regular course; its flanks are constituted by more or less symmetric Jurassic sediments, the core consisting of Upper Cretaceous beds. From Pahnak-Kuh to Fileh-zamin, the course of this syncline is complicated by the presence of a rather complex system of younger faults trending *NW-SE* and *NNW-SSE* (Figure 2).

SUMMARY

The present article is a comparison report of high resolution KFA-1000 imagery of the Lar Dam basin tectonic structure with air photographs and SPOT data. The result shows that KFA-1000 images were useful for the mapping of tectonic structure and hydrdrology network as well. Tectonic structure obtained from KFA-1000 significantly has better understanding than SPOT, LANDSAT and even air photographs in generally. It is significant that most morphologic features and changes are located adjacent of identified forms which is not possible on the SPOT or LANDSAT. On the other hand its interpretation facility and general cost is very reasonable than other data. Stereopairs of KFA-1000 images were used operationally in the completion of a geomorphologic map. The stereoscopic interpretation of black and white and colour KFA-1000 images revealed many previously unmapped tectonic forms and led to the discovery of several formerly undetected active faults, what many influence the sediment supply in the Lar Dam basin. These faults are the results of previous orogenies and play an important role in the morphotectonic of the study area. It can be said that KFA-1000 images provide a

cost-saving alternative to the digital data of the LANDSAT and SPOT system in the field of morphotectonic applications.

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