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Research Paper

Analytical Comparison of Morphotectonic Condition of Subsidence Basins using Fractal Geometry Theory a Case Study the Damghan and Jazmourian Playa

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ARTICLE INFO

Keywords:

Fractal Geometry,
Playa,
Morphotectonics,
Damghan,
Jazmourian.



Received:

06 April 2022

Received in revised form:

10 June 2022

Accepted:

08 August 2022

pp. 133-147

ABSTRACT

Recently, the theory of fractal sets and dimensional fractal measurements have been widely used to describe many tectonic processes. This study aimed to analyze the morphotectonic status of Damghan and Jazmourian playa as two subsidence basins using the fractal dimension results of the fault and drainage, which indicates stagnation or tectonic activity. This study uses the box-counting method, which is the most widely used analysis method in fractal dimension analysis. The data used in this study are the fault system of the studied basins on the scale of 1:250,000 maps of geology and for the model of drainage on the scale of 1:250,000, the Arc Hydro software. The results show that in the Jazmourian region, the southern part of the hole has the highest fractal dimension of the fault and the lowest fractal dimension of the Drainage pattern, which indicates more tectonic activity in this area. After that, the western range and eastern range are located. Finally, according to fractal data, the northern region of Jazmourian experiences more tectonic stillness than other parts. In the Damghan region, the active tectonic zone is the western part with the highest fractal dimension of the fault (1.4034) and the lowest fractal dimension, the Drainage pattern (1.3739). The eastern ranges then show the northern range of the tectonic activity basin, in which many earthquakes confirm this, and finally, the southern range experiences more tectonic stagnation than in other parts.

Citation: Shabani Eraghi, E., & Yamani, M. (2022). Analytical Comparison of Morphotectonic Condition of Subsidence Basins using Fractal Geometry Theory a Case Study the Damghan and Jazmourian Playa. *Geographical planning of space quarterly journal*, 12 (2), 133-147.

<http://doi.org/10.30488/GPS.2022.286229.3404>

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Extended Abstract

Introduction

The geometry used for phenomena and their incorrect dimensions is called fractal geometry, and it describes self-similar or symmetrical objects. This means that when these objects are magnified, there seems to be a precise resemblance between their components, and this resemblance to the component continues indefinitely. In fact, analyzing waterways and their condensation status can be key to identifying the dynamics of an area if good evidence of the area's tectonics is not available. Waterways with an active fault system show useful structural information. Also, the theory of fractal sets and multi-fractal measurements are widely used to describe many tectonic processes, including fault activity. This study uses fractal geometry to analyze and compare the tectonic condition of subsidized basins (Damghan and Jazmourian) located in the center of these plains. After extracting the drainage pattern lines and faults of the area from the fractal dimension analysis, which indicates the dynamics or tranquility of the tectonics, it has been used to determine the lowest and highest tectonic activity of the basin in its various directions relative to the playa.

Methodology

In this study, to evaluate the regions' tectonic condition (dynamism and calmness), some features, geological structures, and drainage network patterns have been used using fractal geometry and their fractal dimension analysis. Also, due to the fault system and drainage pattern, the box-counting method, which is the most widely used method in fractal analysis, has been exerted. This method is used as a mathematical tool for geomorphological studies. In this study, areas in different directions of Playa have been determined for relative recognition of the number of tectonic movements. Then, using the box-counting method in fractal geometry, the fractal dimension is determined, and its results are accompanied by tables of grid size data columns, grid size reversal, grid

size reverse logarithm, number of cells in each box, and number of cells. The enumerated numbers containing faults and waterways are expressed in different directions of Playa. Then, the results of the logarithm of the number of counted houses containing faults and waterways in different directions and the partial fractal dimension and the fractal dimension of the community have been determined and compared by calculating the slope of the regression line.

Result and discussion

Accordingly, the tectonic state is based on the theory of fractal geometry. In the Jazmourian region, the southern part of the hole has the highest fractal dimension of the fault (1.5978) and the lowest fractal dimension of the drainage (1.5424), which indicates more tectonic activity in this area. The study of seismic maps does not confirm the highest number of earthquakes in this area, but considering that the area under study is in the Subduction plates (Saudi Oceanic crust below the Eurasian plate), this area shows the highest tectonic activity in the region and confirms the results of fractal geometry. After that, the western and eastern ranges are located close to each other with fault figures, and as a result, the area where the fractal dimension of the waterway is less being considered to be the more active area (western area). Also, the more significant number of earthquakes indicates more tectonic activity for the western part, which confirms the above view. Then there is the eastern part, which has the highest number of faults. Finally, according to fractal data, the northern region of Jazmourian experiences more tectonic stillness than other parts. In the Damghan region, the western part with the highest fractal dimension of the fault (1.4034) and the lowest fractal dimension of the drainage network (1.3739) indicates a more technically active area. This region has the highest number of earthquakes compared to other ranges, thus showing more tectonic activity. After that, the eastern ranges are active according to the fault's fractal dimensions and the active area's drainage network. Then, the northern

range of the basin shows tectonic activity, in which a large number of earthquakes confirm this, and finally, the southern range experiences more tectonic stillness than other parts. Also, in Damghan and Jazmourian, the partial fractal dimension of faults in the western part of society is more disturbing. In the community of Astaneh Jazmourian, there is a regular decreasing trend, but in the case of Damghan, there is a repetition of more numbers and a relatively small irregularity.

Conclusion

In the Jazmorian region, the most active tectonic range around the Jazmorian hole with the center of Playa is the southern, western, eastern, and northern regions, respectively. However, in the Damghan region, the most active tectonic range is the western, eastern, northern and southern regions, respectively.

Funding

There is no funding support.

Authors' Contribution

Authors contributed equally to the conceptualization and writing of the article. All of the authors approved the content of the manuscript and agreed on all aspects of the work declaration of competing interest none.

Conflict of Interest

Authors declared no conflict of interest.

Acknowledgments

We are grateful to all the scientific consultants of this paper.