DIAPIR-RELATED FISSURES IN THE AMIAZ PLATEAU

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INTRODUCTION

Salt diapirs often push overlying rocks upward, creating domal structures above them. In places where the conditions for oil formation and migration exist, these domes become a potential oil trap. Data on the detailed shape of the top of the diapir are therefore essential for oil prospecting. One possible source for such data are the rock formations penetrated by the salt. Their style of deformation may contain information on the shape and location of the intruding salt body. We suggest that the array of radial and tangential fissures in the Amiaz Plateau is an example of such diapir-related deformation.

The Amiaz Plateau (Fig. 1) is a 3- to 4-km-wide graben enclosed between two N-S striking faults. Its exposed section includes the Samra and the Lisan lacustrine formations, both were deposited in lakes that preceded the modern Dead Sea in the Pleistocene. The Amiaz Plateau is bounded on the east by the Mount Sedom salt diapir, and on the west by the main Dead Sea graben fault (Fig. 1). The Dead Sea basin is a pull-apart graben that lies between two parallel segments of the Dead Sea Rift, the active sinistral transform fault between the Sinai and the Arabian plates (Garfunkel, 1981).

The marine and lacustrine sediments in the tectonic depressions along the transform indicate that it was flooded several times. The Sedom salt that was deposited during the Neogene transgression is the earliest marine sediment that fills the transform depression (Zak, 1967; Agnon, 1983). An earlier study suggested that the salt is of Late Pliocene age (Zak, 1967). The salt diapir pierced the overlying Amora, Samra, and Lisan formations. It is portrayed as a N-S striking "wall diapir" by Zak (1967) and Weinberger (1992), who also described the deformation in and around the diapir. However, Zak (1967) pointed out that the exact shape of the diapir, in particular its sub-surface part, is more complex.

POST-LISAN DEFORMATION IN THE AMIAZ PLATEAU

We mapped the fissures in the Amiaz Plateau which cross the Samra and Lisan formations (Fig. 2) that are exposed due to a 50 m incision of the Perazim Valley. These are vertical extension fissures, up to 30 cm wide with no indication for shear movement. Horizontal offset is not observed, the fissures do not displace each other upon intersection. The fissures are filled with fragments of the Lisan rocks, commonly mixed with some brown sand, the same type that covers the Lisan Formation and forms part of the Amiaz Plateau. In places the rims of the fissures are indurated by crystalline calcite, probably the product of recrystallization of aragonite. Many tributaries of the Perazim Valley follow fissure strikes.

The strike directions of the fissures form mainly radial and tangential systems (Fig. 2) and a few fissures strike in other directions. The radial system spans a range of 60° and converges eastward; its southernmost trace strikes 60° and the northmost strikes 120°. The tangential system spans over 90°; its southernmost trace strikes 150° and the northmost, 060°. The continuation of the radial set of fissures eastward converges at a domal structure of post-Lisan alluvial sediments, topographically elevated some 20 m above the Amiaz Plateau, known as the "Black Hill" (Zak, 1967).

INTERPRETATION

A paired system of vertical radial and tangential extension fissures exhibit lateral extension without vertical movement. This state is compatible with the deformation near a cylindrical intrusion. The strain is different in the Black Hill where vertical movement controls the topography. The morphology of the Black Hill and the convergence of the radial fissure set support the hypothesis that an actively rising projection of the Sedom salt diapir is concealed underneath (Zak, 1967). The fissure fill and the general incision pattern of the Perazim drainage basin dictated by the fissure array suggest that the fissures postdate the drying of Lake Lisan. In contrast to the post-Lisan fissures, syn-depositional extension is manifested in the Lisan Formation as normal faults (Marco and Agnon, 1995).

A numerical analysis (O'Brien and Lerch, 1987) predicts extension features and thinning of the rocks overlying a salt diapir. Experiments also show extension

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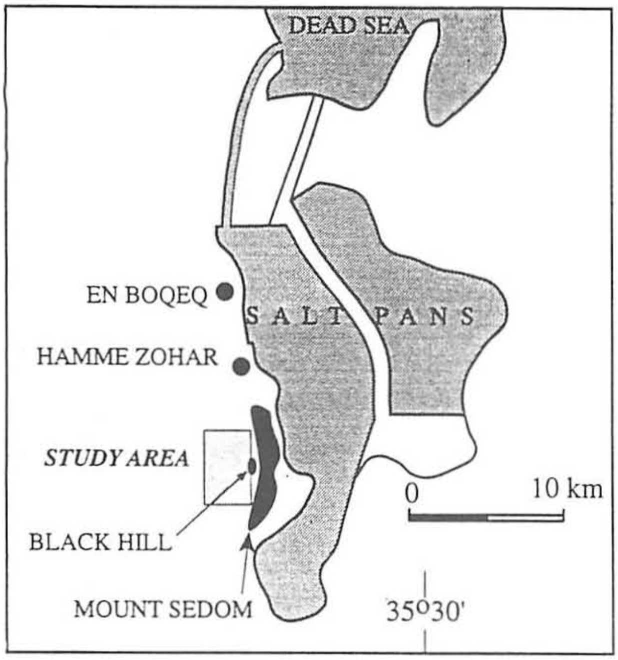

Figure 1. Location map.

by normal faulting above and close to rising diapirs (Childs et al., 1993; Davison et al., 1993). The phenomenon described herein has not been previously reported. Additional data on the detailed geometry of the fissures and their filling may yield a spatio-temporal model of diapir intrusion with implications on the strain in the underlying diapir and on deformation of the Lisan Formation that is drier and slower compared to the syn-depositional faulting.

REFERENCES

Agnon, A., 1983. An attempted revision of the Neogene stratigraphy in the Dead Sea Valley. Isr. Geol. Soc. Annu. Meet., Abst., p. 1.

Childs, C., Easton, S. J., Vendeville, B. C., Jackson, M. P. A., Lin, S. T., Walsh, J. J. and Watterson, J., 1993. Kinematic analysis of faults in a physical model of growth faulting above a viscous salt analogue. Tectonophysics, 228:313-329.

Davison, I., Insley, M., Harper, M., Weston, P., Blundell, D., McClay, K. and Quallington, A., 1993. Physical modeling of overburden deformation around salt diapirs. Tectonophysics, 228: 255-274.

Garfunkel, Z., 1981. Internal structure of the Dead Sea leaky transform (rift) in relation to plate kinematics. Tectonophysics, 80: 81-108.

Marco, S. and Agnon, A., 1995. Prehistoric earthquake deformations near Masada, Dead Sea graben. Geology, 23:695-698.

O'Brien, J. J. and Lerch, I., 1987. Modelling of the deformation and faulting of the formations overlying an uprising salt dome. In: I. Lerch and J.J. O'Brien (eds.), Dynamical Geology of Salt and Related Structures, Academic Press, pp. 419-455.

Weinberger, R., 1992. Paleomagnetism in Mount Sedom, Israel: a method to determine the structure of the salt body and to reconstruct its emergence from the subsurface. .Sc. Thesis, Hebrew Univ., Jerusalem (in Hebrew).

Zak, I., 1967. The geology of Mount Sedom. Ph.D. Thesis, Hebrew Univ., Jerusalem (in Hebrew).

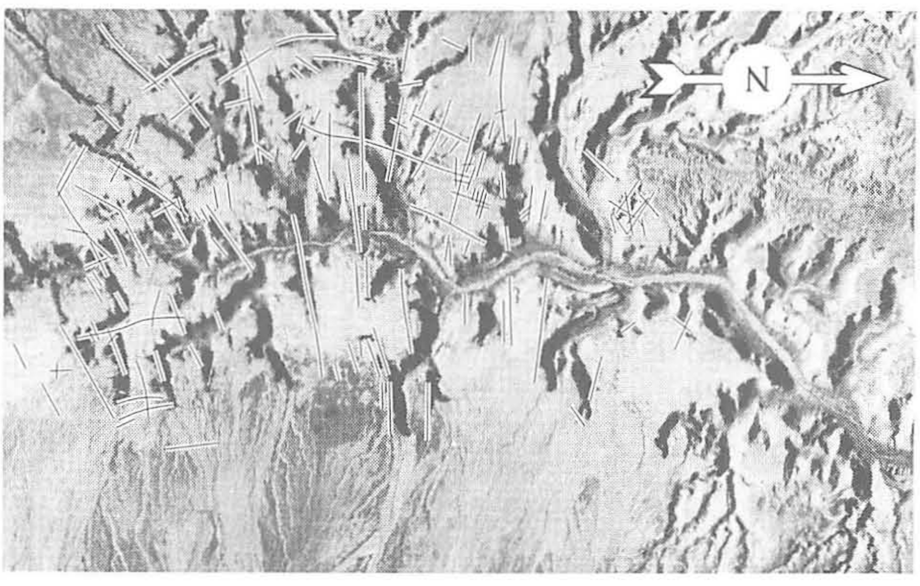

Figure 2. Fissure traces shown on an airphoto of the Amiaz plateau. Many tributaries of the Perazim Valley follow fissure traces.