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Geoscientific Interpretation of Cosmic photograph taken from the Eastern Foreland of the Harz Mountains

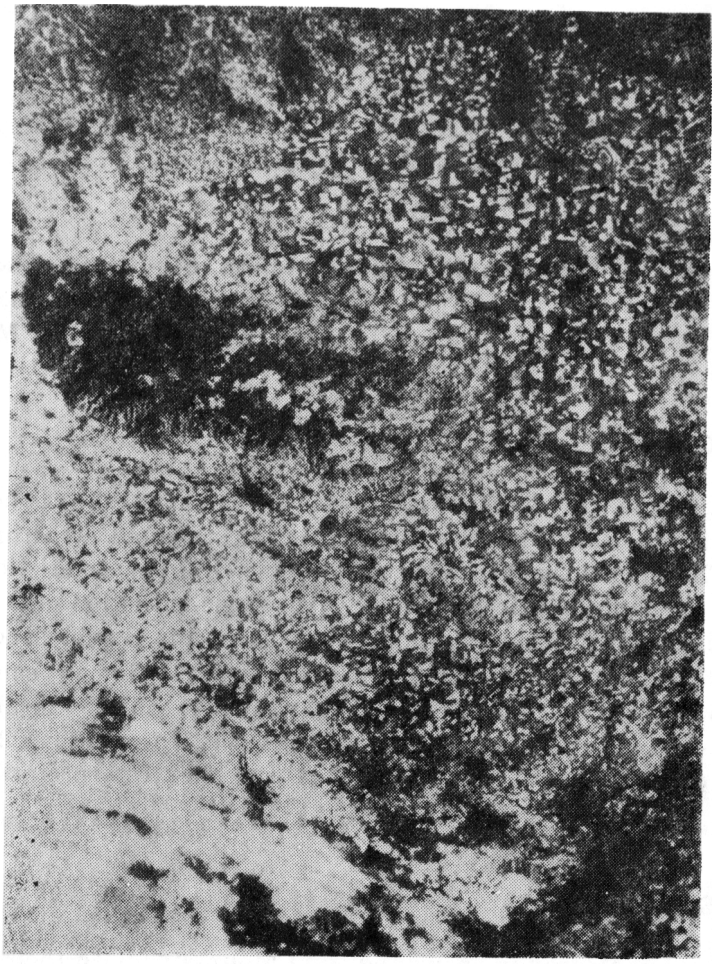
INTRODUCTION

The geoscientific interpretation of cosmic or satellite photographs is of great importance for the analysis of the regional structure of territories. The present article deals with identifying characteristics of geologic and geomorphologic structure, hydrologic situation and land-use which are tested in a photographic image from the Soviet space station „SALUT-6" taken by multispectral camera MKF-6m (6 canals from 460 nm to 890 nm — Phot. 1) in a flight altitude of 250 km above ground. The original scale of image is 1 : 2 000 000. The methods here used are those of visual interpretation with help of the „Interpretoskop" from VEB Garl Zeiss Jena.

THE INVESTIGATED AREA

The whole photography shows the Harz Mountains with their northern, etstern and souther forelands. For this study (fig. 1) a region was selected of about 720 km² between the Harz mountains in the west and the Saale river in the east. This territory is one of the most important industrial regions of the GDR with a high concentration of settlements, industries and mining and with an intensive agriculture. The industrial centres and greatest towns are Halle (235 000 inhabitants), Merseburg (52 000), Halle-Neustadt (100 000), Eisleben (30 000), Leuna and Schkopau.

The geological structure is characterized by palaeozoic and triassic volcanic and sedimentary rocks and a caenozoic sediment cover. The studied area is divided in hummocky regions, flat upland areas and flat as well as steep-sloped valleys.



Phot. 1. Cosmic photograph of the Harz mountains and their northern, eastern and southern forelands taken from the Soviet space station „SALUT-6" in 1978, camera MKF-6, canal 6

Fot. 1. Zdjęcie satelitarne Gór Harcu, ich północne, wschodnie i południowe przedpole, wykonane z radzieckiej stacji orbitalnej „SALUT-6" w 1978 roku kamerą MKF-6 w kanale 6

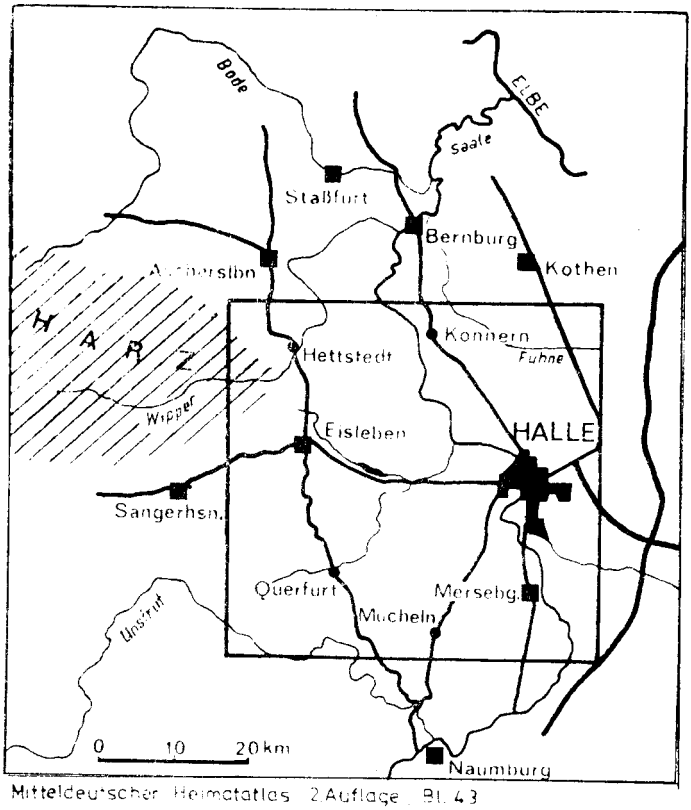


Fig. 1. The investigated area
Ryc. 1. Badany obszar

INTERPRETATION OF SOME GEOLOGICAL FEATURES

Plotting linear elements (lineaments, photolineations) is very important for geologic and tectonic interpretation (fig. 2). This investigation, however, in Middle Europe renders more difficult because of the vegetation and soil cover as well as the high degree of intensive land-use in

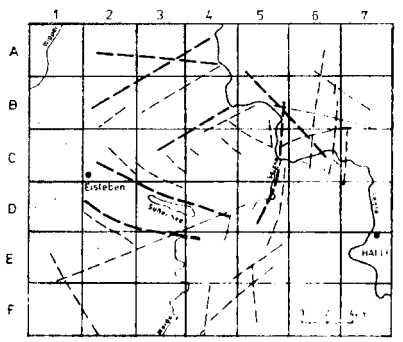


Fig. 2. Photolineations (lineaments, interpreted from cosmic photograph
Ryc. 2. Lineamenty uczytelnione na zdjęciu satelitarnym

being. The image allows photolineation to be identified with equally grey-toned rectilinear elements in the soil cover, with vegetation bands, boundaries of land-use areas and with rectilinear valley directions. The identification successeds especially within the canals 5 and 6 (near infrared radiation). The comparison of the interpretation results with terrestical measurements of fissure directions shows the geological relevance of the lineations (fig. 3). The main directions of photolineations are

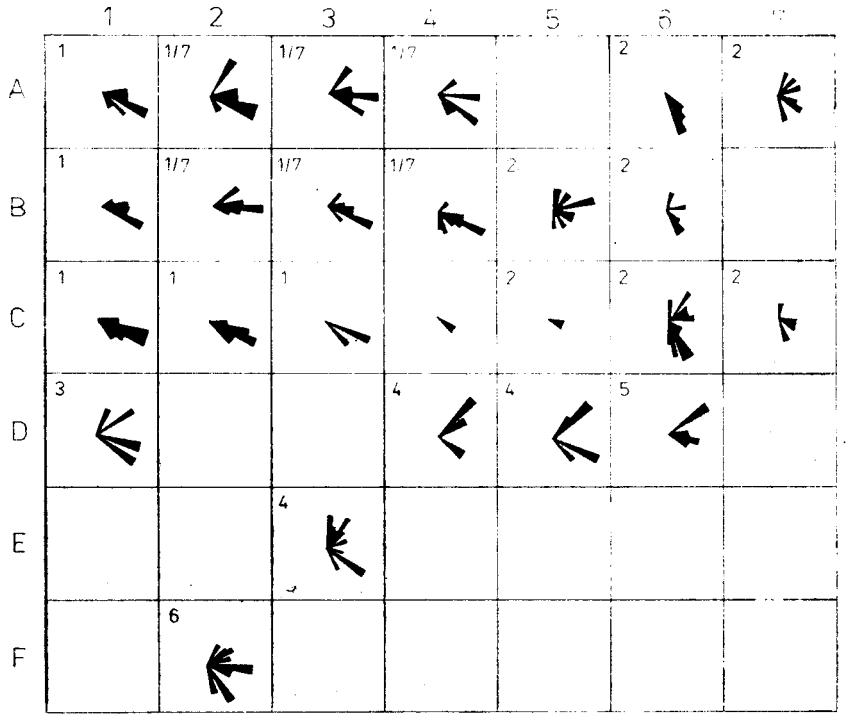


Fig. 3. Results of terrestical measurements of fissure directions in the investigated area (map grid compare with fig. 2)

Ryc. 3. Wyniki naziemnych pomiarów kierunków szczelin na badanym obszarze (siatkę mapy porównaj z ryc. 2)

N-S, in connection with a superregional rhenotype structure zone, NE--SW, in this direction also tectonic structures striking in the mesozoic rocks, and NW-SE (hercynian) as the main direction in the subsalinar basement and of suberosional processes.

DRAINAGE NETWORK AND GEOMORPHOLOGICAL STRUCTURES

The drainage network gives the basis for a territorial dividing. The mapping of drainage founded on satellite images enables to get informations upon the petrographic, tectonic, morphologic, climatic and hydrolo-

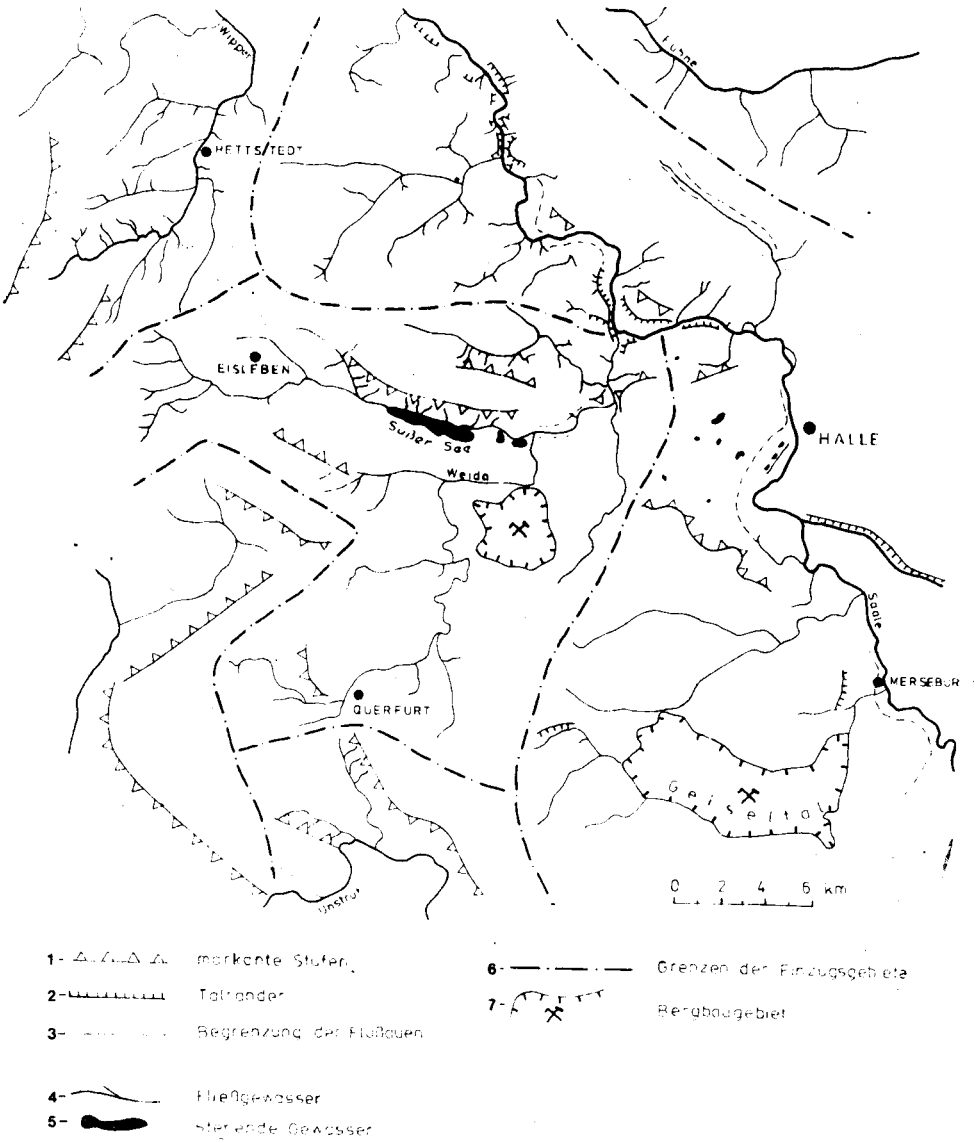


Fig. 4. Drainage network and main geomorphological features, interpreted from MKF-6 photograph:
1 — marked steps, 2 — valley borders, 3 — boundaries of flood plains, 4 — flowing waters, 5 — standing waters, 6 — boundaries of drainage ares, 7 — mining areas

Ryc. 4. Sieć rzeczna i główne elementy geomorfologiczne uczytelnione ze zdjęcia wykonanego kamerą MKF-6:
1 — znaczne stopnie terenowe (stoki), 2 — granice dolin, 3 — granice obszarów zalewanych, 4 — wody płynące, 5 — wody stojące, 6 — działy wodne, 7 — obszar górniczy

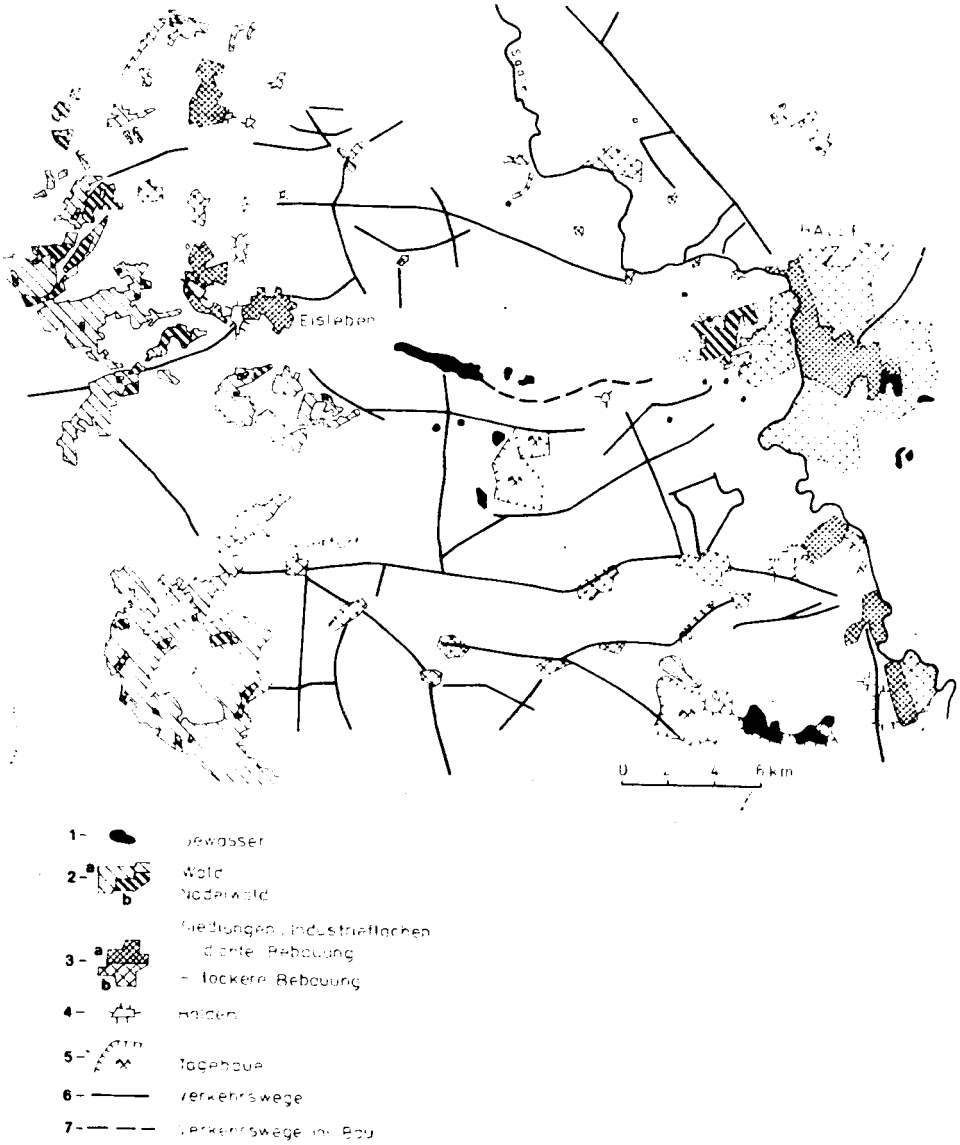


Fig. 5. Non-agricultural land-use of the investigated area interpreted from cosmic photograph:

1 — waters, 2a — forest, 2b — coniferous forest, 3 — settlement and industrial areas: a — densely built-up, b — sparsely built-up, 4 — dumps, 5 — open-cast, 6 — roads, 7 — roads in building

Ryc. 5. Pozarolnicze użytkowanie ziemi badanego obszaru uczytelnione ze zdjęcia satelitarnego:

1 — wody, 2a — lasy, 2b — lasy iglaste, 3 — obszary zasiedlone i przemysłowe: a — zabudowa zwarta, b — zabudowa luźna, 4 — hałdy, 5 — wyrobisko, 6 — drogi, 7 — drogi w budowie

gic situation (fig. 4). Water areas with a width of about 6 m (limited by the photographic resolution) can be seen directly, especially in the near infrared canal 6, whereas all the other hydrologic elements are interpreted indirectly by features of land-use, vegetation or pattern in canal 4 (640—680 nm).

The east foreland of the Harz is characterized by a small autochthon flowing off. Therefore the density of drainage networks is small. The main rivers of the region are Saale, Unstrut and Wipper. Rivers in parts, especially when running through regions with palaeozoic rocks, are dependent on tectonics. Such a situation may be seen very distinctly the north of Halle.

The open water areas in the analysed area have resulted from suberosion processes (lake „Süßer See" near Eisleben) or from mining (waterfilled open-casts).

The main geomorphological structures as escarpments, valley borders and slopes as well as riverside meadows are detectable by characteristic vegatation arrangements or by differences in land-use to other areas. In the west and south-west part of the area the benchlands between mesozoic limestones and sandstones are marked geomorphologic and landscape lines. The wides flood plain of the Saale river, which differs in its grey tone and texture from the plateau areas, was caused by suberosional processes as salt wash surface valleys.

LAND-USE

The main elements of land-use can be interpreted from satellite photographs (fig 5). The present investigation focuses in non-agricultural forms of land-use. The actual mapping of dynamic forms of land-use, as settlement areas or mining areas, is very important for regional planning. The best informations for this purpose can be learned from the photographs in canal 4 (640—680 nm) and canal 6 (790—890 nm). Table 1 gives a short interpretating key for some forms of land-use.

The map of non-agricultural land-use made by interpreting the cosmic photograph illustrates the high concentration of settlements and industries in the area, demonstrating also the lack of forests and water areas and, so far, the resultant problems for recreation.

To test the photograph for the fine structure analysis a sixfold enlargement of an image sector was made. Fig. 6 shows the result within an area around the lake „Süßer See" to the west of Halle. The agricultural land-use with spacious fields can be detected very exactly by the analysis of pattern, texture and greytone. But special forms of land-use as archards, waste land, pleasure grounds, building areas can be inter-

preted in complex units only. The application of aequidensitic electronical made images and their comparision with air photographs support the interpretation process.

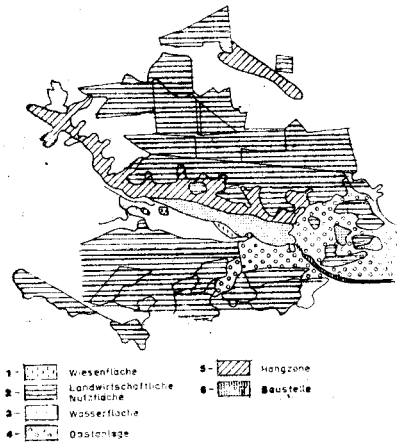


Fig. 6. Land-use interpretation from the enlarged section of the cosmic photograph:
1 — meadows, 2 — arable land, 3 — waters, 4 — orchards, 5 — slope zone, 6 — building site

Ryc. 6. Użytkowanie ziemi powiększonego wycinka badanego obrazu uczytelnione ze zdjęcia satelitarnego:
1 — łąki, 2 — ziemie orne, 3 — wody, 4 — sady, 5 — strefa zboczowa, 6 — obszar zabudowany

Table 1

Multispectral canal	Forms of land-use	Display in the positive image
4	wood areas	black or darkgrey (small remission), spotted texture sharp, often rectilinear boundary
	traffic ways	indirectly by pattern of land-use areas, only in some parts of image
6	water areas	deepblack (very small remission), without of texture, very sharp boundaries, position to other elements
	wood areas	discrimination between coniferous (darkgrey) and leafy wood (lightgrey)
	settlement and industrial areas	
	a) densely builtup	darkgrey, small spotted texture
	b) sparsely builtup	middle grey, small spotted texture, diffuse boundaries
	mining areas	
	a) waterfilled residual opencast	black, sharp boundaries
	b) open-cast	darkgrey, spotted-striped texture, rectilinear boundaries
	c) dumps of brown coal mining	lightgrey, rectancular outline, striped structure
	d) dumps of copper mining	black, circulare or quadratic outline

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KOMPLEKSOWA INTERPRETACJA ZDJĘĆ SATELITARNYCH WSCHODNIEGO PRZEDPOLA GÓR HARCU

Streszczenie

W pracy przedstawiono wyniki wizualnej, kompleksowej interpretacji treści wielospektralnych zdjęć satelitarnych obejmujących północne, wschodnie i południowe przedpole Gór Harcu, które zajmuje powierzchnię około 720 km². Interpretowane zdjęcia satelitarne wykonane zostały w 1978 roku z pokładu radzieckiej stacji orbitalnej „SALUT-6" kamerą wielospektralną MKF-6 z wysokości 250 km.

Analizie poddano powiększone zdjęcia satelitarne, których oryginalna skala wynosiła 1 : 2 000 000. Stosując tę bardzo prostą metodę, uczytelniano takie elementy jak: zasadnicze rysy budowy geologicznej formy rzeźby terenu, sieci hydrograficznej, sieci dróg, zabudowy oraz użytkowania ziemi.

GERD VILLWOCK

INTERPRÉTATION GÉOSCIENTIFIQUE DE PHOTOGRAPHIES COSMIQUES DE LA RÉGION SUBMONTAGNEUSE ORIENTALE DES MONTAGNES DU HARZ

Résumé

Dans le présent article nous avons présenté les résultats de l'interprétation visuelle géoscientifique du contenu de photographies cosmiques polyspectrales englobant les régions submontagneuses septentrionale, orientale et méridionale des montagnes du Harz qui recouvrent une superficie d'environ 720 km². Les photographies cosmiques interprétées ont été effectuées en 1978 à bord de la station orbitale soviétique „SALUT-6" à l'aide d'une caméra polyspectrale MKF-6 à l'altitude de 250 km.

Nous avons soumis à analyse les agrandissements de photographies cosmiques dont l'échelle originale était de 1 : 2 000 000. Appliquant cette méthode très simple, nous avons lisibilisé des éléments tels que les traits fondamentaux de la structure géologique, les formes de relief du sol, du réseau hydrographique, du réseau routier, des constructions et de l'utilisation du sol.

(Traduit par Michał Michalak)