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Stručni članak

Ring Structures of France

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Ključne riječi: Prstenaste strukture, Geološka građa, Izgled reljefa, Geografske karte.

Ring structures of France have been singled out according to geological structure and appearance of the relief using for the purpose suitable maps of small scale.

The Central Massif and the Paris Basin, which stand out by their size and peculiar nature of their development, make up the basic ring structural units of France.

The Rhone trough separates the Central Massif from the West-Alpine marginal ring structures of smaller diameters such as Provence and Genève. Numerous ranges of ring structures of smaller diameters are another characteristic of the ring-tectonic structure of France. The use of the terms »geological structure« or »relief ring structure« is also discussed.

Geološke i reljefne prstenaste strukture područja Francuske izdvojene su prema geološkoj građi i izgledu reljefa na odgovarajućim zemljopisnim kartama sitnog mjerila.

Centralni masiv i Pariški bazen osobito se ističu veličinom i osebujnošću svog razvitka. Oni čine osnovne prstenaste strukturne jedinice terena Francuske.

Rhonska graba razdvaja Centralni masiv od zapadnoalpskih graničnih prstenastih struktura manjeg promjera, kao što su Provence i Genève. Brojni nizovi prstenastih struktura malih promjera također su odlika prstenaste tektonske građe terena Francuske.

Upotreba naziva »geološka« odnosno »reljefna prstenasta struktura« približe je razmatrana.

INTRODUCTION

Territory of France is characterized by complex geological structure. It is formed of tectonic units of various origin, areal distribution and morphological characteristics. Some of these units spread in a circular, oval or spiral shape, forming in such a way so called ring structures. According to their origin, the ring structures are classified into endogenous and exogenous forms. B r j u h a n o v et al., (1987) classify endogenous structural ring forms into metamorphous, magmatic and tectonic units. Exogenous forms include cosmogenic or impact units which developed under the influence of meteorites, and units resulting exclusively from erosion processes.

Some of the most conspicuous ring structures of France, such as the Central Massif and the Paris Basin, have already been pointed out by Bush et al. (1983), Klein (1985) and Brjuhánov et al. (1987).

In order to ensure a more complete presentation of the ring structures of France a geological map of France was used in this work, in addition to relevant geographical maps of small scales, while a satellite photos of the same region helped to gain a fuller idea of the relations under study.

It should be mentioned here that there is no generally accepted terminology for tectonic units of ring and similar delineations. The reason for this should be sought in the fact that the knowledge about their nature is steadily growing. For instance, under the term »ring structure« it is often understood not only the circular outline set off with a darker shade which can be observed on satellite photographs, but also ring, oval and spiral structures singled out according to their geological structure and relief features.

Taken generally, the term »ring structure« has a collective meaning and may be used for all forms regardless of their origin.

Trying to find a suitable term for the requirements of a more detailed classification of these structures, Brjuhánov et al. (1987) introduced the term »geological ring structure« for ring units singled out exclusively according to geological data. Thus it appears quite justified to use the term »relief ring structure« also for ring units singled out exclusively according to the appearance of the relief.

If a singled-out relief ring structure is a direct reflection of the geological structure, it would also represent the »ring morphostructure«.

WORKING METHODS

In this work the ring structures were singled out by under lining out all ring delineations of geological boundaries and faults on a geological map of France scale 1 : 1,500,000. Thus geological ring structures were singled out (Fig. 1). Subsequently all noticeable ring relief delineations (mountain ranges, valleys, river courses, escarpments, etc.), including those of discontinuous spreading, were singled out on small-scale geographical maps. In this way relief ring structures of France were singled out (Figs. 2, 3, 6).

The relief energy map of France was separately prepared using a small-scale map which made it possible to single out some additional ring-structural units (Fig. 7).

RESULTS

An important role in the tectonic development of France is played by ring structures of various morphogenic types and diameters. Prominent among these basic or comparatively larger forms (medium forms) of ring structures are those with diameters of 250—400 km. More numerous are forms with diameters of 100—150 km (mini-forms), and the most numerous are those with diameters of up to 50 km (micro-forms) — according to the classification of Brjuhánov et al. (1987).

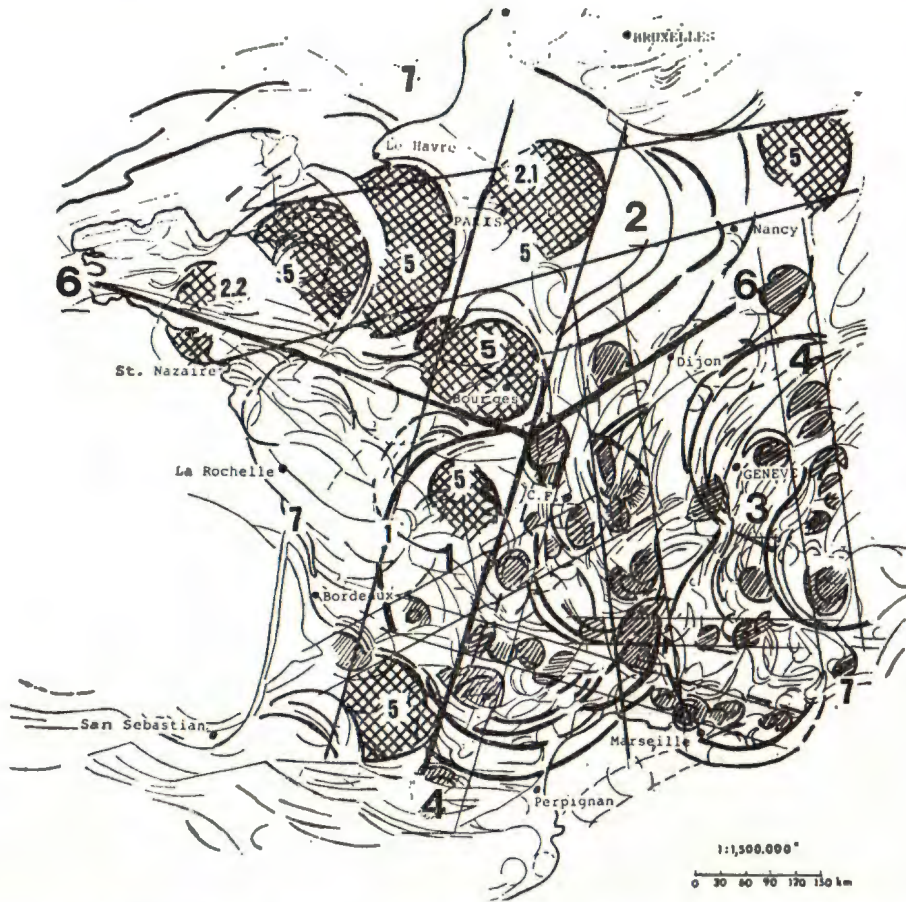


Fig. 1 Ring structures of France singled out on the basis of a geological map of France scale 1 : 1,500,000 (Ministère de l'industrie, 1980).

1 — Ring structure Massif Central; 2 — Ring structural complex of northern France: 2.1. of Paris Basin, 2.2. of Armorican Massif; 3 — West Alpine ring units; 4 — Ring ranges of relatively small diameters; 5 — Ring ranges of medium diameters; 6 — Lines of tripartite division of ring structures of France according to their diameters; 7 — Ring unit segments of different densities.

Sl. 1 Prstenaste strukture Francuske izdvojene prema geološkoj karti Francuske M 1 : 1,500,000 (Ministère de l'industrie, 1980).

1 — Prstenasta struktura Centralni masiv; 2 — Kompleks prstenastih struktura sjeverne Francuske: 2.1. Pariški bazen, 2.2. Armonički bazen; 3 — Prstenaste jedinice Zapadnih Alpa; 4 — Prstenasti nizovi razmjerno malih promjera; 5 — Prstenasti nizovi srednje velikih promjera; 6 — Linije trodjelne podjele Francuske s obzirom na promjer izdvojenih prstenastih struktura; 7 — Segmenti različitih gustoća prstenastih struktura.

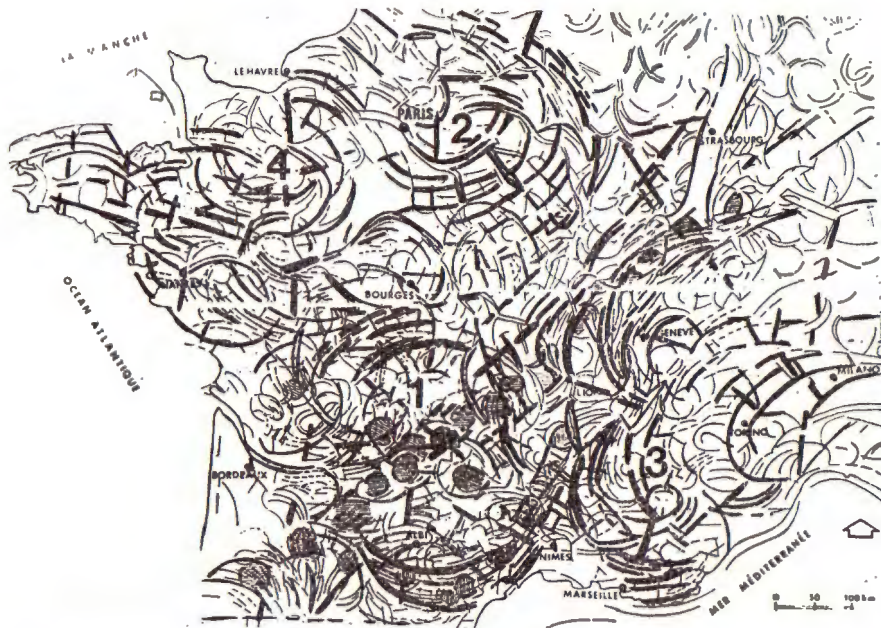


Fig. 2 Prognostic map of ring morphostructures singled out according to map of France scale 1 : 1,000,000 (Institut Geographique National, 1985).

Main ring blocks of morphostructural features: 1 — Massif Central; 2 — Paris Basin; 3 — West Alpine group of ring structures; 4 — Ring structures of wider Armorican Massif area.

Sl. 2 Prognostička karta prstenastih morfostruktura izdvojenih prema zemljopisnoj karti Francuske M 1 : 1,000,000 (Institut Geographique National, 1985).

Osnovni prstenasti blokovi morfostrukturnog obilježja: 1 — Centralni masiv; 2 — Pariški bazen; 3 — Zapadno-alpska skupina prstenastih struktura; 4 — Prstenaste strukture šireg područja Armoričkog masiva.

In southern France there predominates the geological ring structural unit Central Massif with a diameter of 250—300 km (Fig. 1). The basis of its outline is a clearly noticeable semi-circular south-eastern edge of convex orientation. This massif is built mostly of granite and gneiss rock, intersected by numerous faults. Most of these can be observed along the south-eastern edge of the Central Massif. The narrower, north-western marginal part of the Central Massif is intersected by the wider semi-oval delineation of the Paris Basin unit (Fig. 8).

The marginal parts of the Central Massif ring structure are not ideally interlinked. This should be attributed to the character of neotectonic vertical movements taking place when the volcanic phenomena occurred within the Massif in the Quaternary period. The geological ring structure Central Massif is also reflected in the relief (Fig. 2) and thus it also represents the relief ring structure with a number of micro-ring structures within itself.



Fig. 3 Various ring morphostructures of France singled out according to map scale 1:3,500,000. (Published by Tlos — Skolska knjiga, 1982.)

Sl. 3 Prstenaste morfostrukture Francuske izdvojene prema zemljopisnoj karti M 1:3,500,000. (Izdao Tlos — Skolska knjiga, 1982.)

In the northern part of France there stands out the ring structure Paris Basin. It is built of a Mesozoic sequence (thickness about 3,000 m), which is overlaid by young Tertiary layers uplifted by slight neotectonic movements. These layers reveal the presence of further ring structures of smaller diameter inside the Basin. Towards the east, the Paris Basin adjoins broader, semi-ring structural belts (Fig. 8).

Towards the west, the concavely retracted marginal parts of the Paris Basin are of asymmetrical delineation in relation to the eastern marginal parts which are convexly turned eastwards (Fig. 8). To the west of the Basin, in the region of Normandy and Bretagne, there spread uplifted ring structures (of hercynian origin) of the Armorican Massif. Viewed as a whole, the Paris Basin presents an asymmetric geological semi-ring



Fig. 4 Simplified map of ring morphostructures of France prepared according to Fig. 3.

Sl. 4 Pojednostavljena karta prstenastih morfostruktura Francuske izrađena prema slici 3.

structure. It is over-laid by a more completely developed relief ring structure, and this points to the influence of vertical neotectonic movements.

By analysis of the relief, new information was obtained about the ring delineations of rock complexes or tectonic structures of France. This gives sense and justification to the study of ring structures of the Earth's crust.

Since the marginal parts of the Paris Basin, delineated in its geological structure, generally conform with those of its relief, the singled out ring structural unit has a morphostructural meaning. Its diameter varies from 300—350 km.

In the region of the Armorican Massif there stand out several ring structures with diameters from 100 to 150 km which indicate the trends



Fig. 5 Variant of the division of ring morphostructures of France according to Fig. 3.

1 — Central range of small ring morphostructures which divides the territory of France into two parts; 2 — The southwestern part.

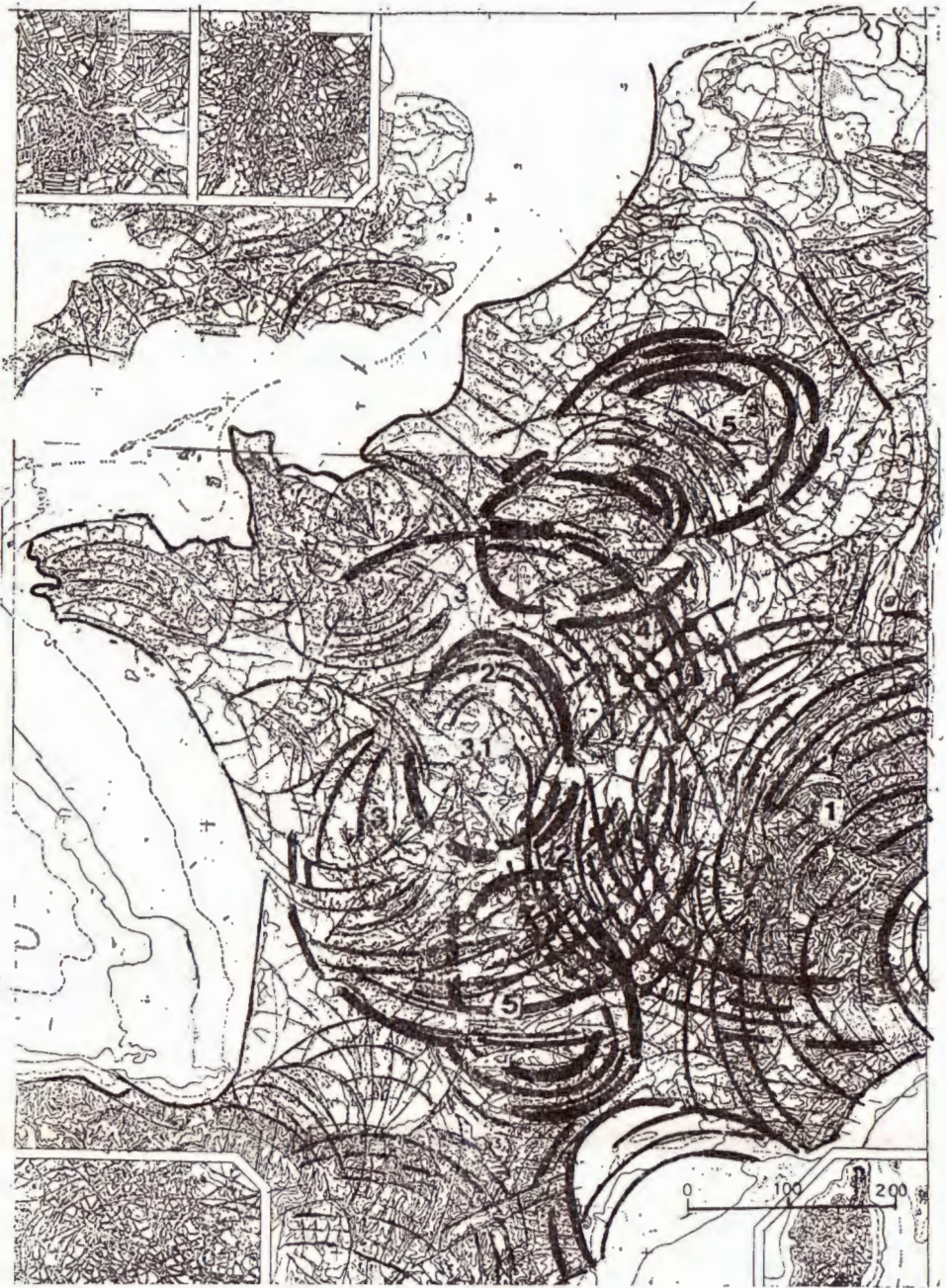
Sl. 5 Varijanta podjele prstenastih morfostruktura Francuske prema slici 3.

1 — Središnji niz malih prstenastih morfostruktura (koji uvijek dijeli teritorij Francuske na jugozapadni i sjeveroistočni dio); 2 — Jugozapadni dio.

in the formation of a larger, disguised ring-structural unit. This massif is intersected by a faulting zone which runs in a WNW—ESE direction.

The Rhone trough, extending in a N—S direction, separates the Central Massif (formed on a hercynian basement) from the west-alpine ring morphostructures Provence and Genève which lie farther to the east (Fig. 1, 2).

Here can be observed a conforming relation between the areal distribution of the singled out ring-structural units and the manner in which they are integrated in the geological structure of the west-alpine overthrusting complex.



Most ring-structural units of France represent ring morphostructures reflecting the conformity between geological and relief features. However, many disconforming relations can also be observed on the territory of France.

For instance, within parts of the west-alpine ring morphostructures a series of relief arches can be observed, the convex sides of which are turned westwards (Fig. 6). Arches of the same orientation can also be singled out on the western side of the Rhone trough, i. e. within the eastern parts of the Central Massif. Here they intersect with the arches of the relief of the Central Massif which, however, are convexly turned towards the east (Fig. 8). Thus they create numerous intersections which results in a greater fracturization of the ground. In contrast to the units Provence and Genève the ring delineations of the Central Massif relief do not show a tendency of spreading beyond their immediate area, thus revealing in a certain way a passivity of the Central Massif in this respect. This is supported by the fact that the Central Massif marginally cuts into the outer semi-ring shaped belt of the Paris Basin. An example of a marked overlapping is the intersection of the outer semi-ring delineations of the Aquitanian Basin with those of the Central Massif. In Fig. 8 one can also notice the possibility of a general division of France into a northern and a southern ring-structural complex as regards the way in which ring delineations of the Armorican Massif are intergrated in the larger Paris Basin. These relations are also suggested by the enclosed morphometric relief energy map of France (Fig. 7). The overlapping of relief ring structures can also be seen in Fig. 4, which has been prepared according to the map of relief ring-structural delineations shown in Fig. 3.

In some of the figures numerous mini and micro-forms of ring structures were singled out. In view of their numerousness it is not possible to describe them individually. They form numerous ranges, mostly linear ones, but also ringshaped ones, which mutually intersect and at the

Fig. 6 Basic characteristics of ring morphostructures of France singled out according to a relief map scale 1:1,000,000 (IRO Kartografija, 1986).

Ring relief delineations: 1 — Related to the uplifting of the Alps; 2 — Of the Massif Central and convexly oriented towards the Alps; 3 — Ring morphostructure Massif Central, 3.1. — The core; 4 — Intersections of ring relief delineations of the Massif Central convexly oriented towards the Alps and of those convexly oriented towards the west; 5 — Range of ring morphostructures of smaller diameters which cross the territory of France and curve round the Western Alps.

Sl. 6 Osnovna obilježja prstenastih morfostruktura Francuske izdvojenih prema reljefnoj karti M 1 : 1,000.000 (IRO Kartografija, 1986).

Prstenasti ocrti reljefa: 1 — Postankom vezani uz izdizanje Alpa; 2 — Centralnog masiva konveksno okrenuti Alpama; 3 — Prstenasta morfostruktura Centralni masiv, 3.1. — Jezgra; 4 — Presjecišta između prstenastih ocrta reljefa Centralnog masiva konveksno okrenutih prema Alpama i onih konveksno okrenutih prema zapadu; 5 — Niz prstenastih morfostruktura manjeg promjera koji presjeca teritorij Francuske i povija se oko Zapadnih Alpa.

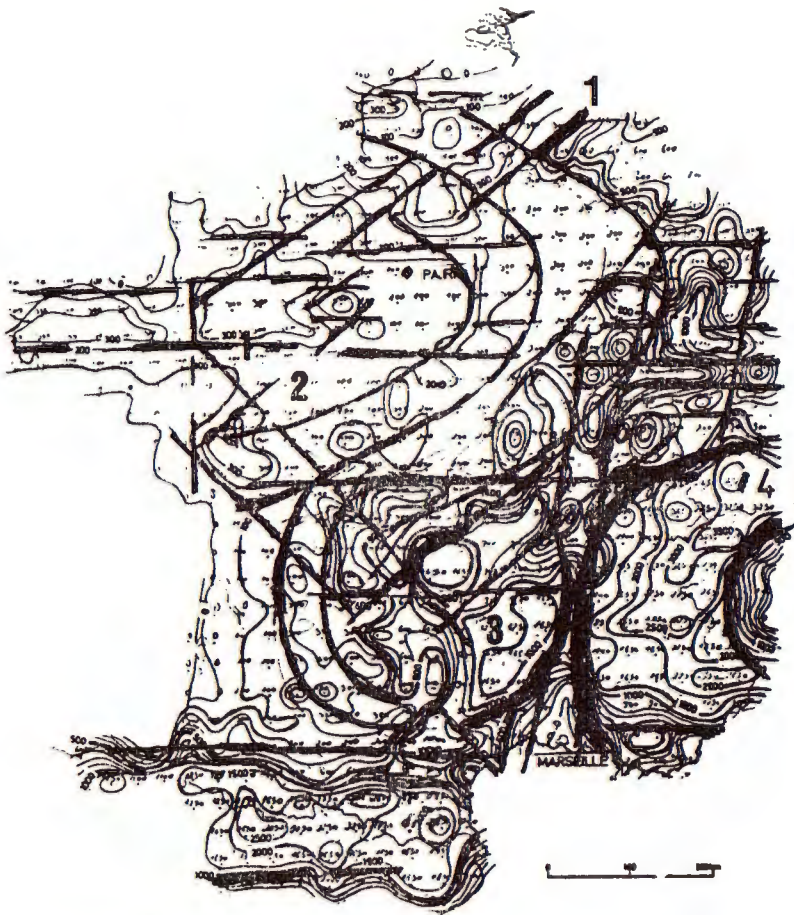


Fig. 7 Prognostic morphometric-tectonic map of France prepared on the basis of a map of France scale 1:3,500,000 (Tloš — Školska knjiga, 1982).

1 — Supposed faults; 2 — Semi oval morphostructural complex of northern France which unifies the areas of the Paris Basin and the Armorican Massif into a larger one; 3 — Ring morphostructural Massif Central; 4 — Ring belt of the relief of the Western Alps.

Sl. 7 Prognostička morfometrijsko-tektonska karta izrađena prema zemljopisnoj karti Francuske M 1:1,000,000 (Tloš — Školska knjiga, 1982).

1 — Pretpostavljeni rasjedi; 2 — Eliptički morfostrukturni kompleks sjeverne Francuske koji sjedinjuje područje Pariškog bazena i Armoričkog masiva uvjetno u jednu veću cjelinu; 3 — Prstenasta morfostrukturna jedinica Centralni masiv; 4 — Prstenasti pojas reljefa Zapadnih Alpa.

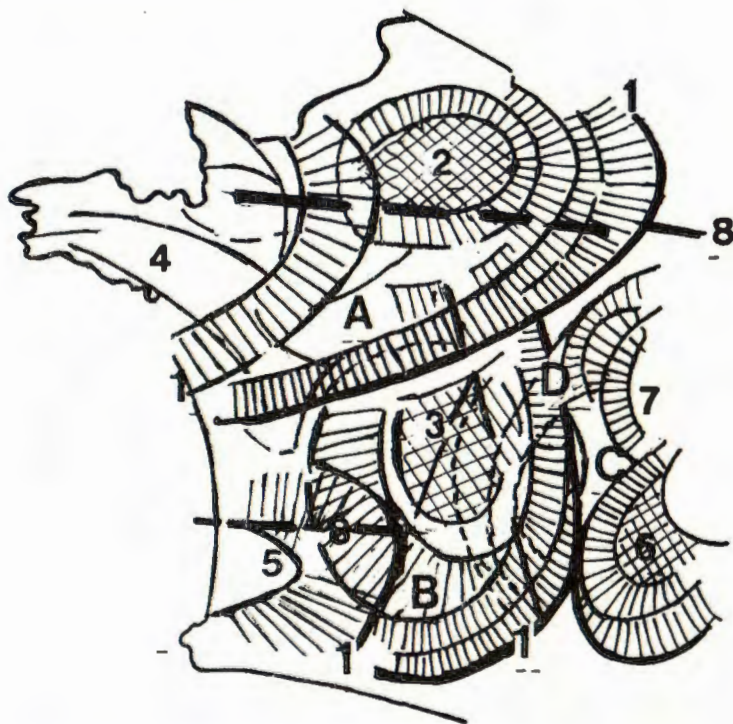


Fig. 8 Sketch map of basic ring complexes of France prepared on the basis of a simplified geological map of France. Editor: Service geologique National du Bureau de recherches géologiques et minière).

A — Northern: (2 — of the Paris Basin and 4 — of the Armorican Massif),
 B — Southern (3 — of the Central Massif and 5 — of the Aquitanian Basin),
 C — Alpine border belt,
 D — Marginal belt of the Rhone,

1 — Boundaries of semi-ring structures orientated towards the east: 2 — Paris Basin, 3 — Central Massif, 4 — Armorican Massif, 5 — Aquitanian Basin,

6 — Ring structure Provence, and 7 — Ring structure Genève,

8 — Longer axes of semi-ring structures marked 2 and 5.

Sl. 8 Karta osnovnih prstenastih kompleksa Francuske izrađena na osnovi pojednostavljene geološke karte Francuske. (Editor: Service geologique National du Bureau recherches géologiques et minière).

A — Sjeverni: (2 — Pariskog bazena i 4 — Armoričkog masiva),

B — Južni (3 — Centralnog masiva i 5 — Akvitanskog bazena).

C — Rubni — Alpski,

D — Granični pojas Rhone,

1 — Granice prstenastih struktura orjentiranih prema istoku; 2 — Pariski bazen; 3 — Centralni masiv; 4 — Armorički masiv; 5 — Akvitanski bazen,

6 — Prstenasta struktura Provence i 7 — Genève,

8 — Duže osi poluprstenastih struktura oznake: 2, 5.

same time link together different structural units (Figs. 1, 2, 6). Highly conspicuous in Fig. 6 is the ring-shaped range which curves the western Alps.

On the basis of the small-scale map of relief ring structures of France (Fig. 3) other ring structure ranges of very small diameters were singled out. It runs from the mouth of the Rhone towards Rouen (Fig. 5), and is partly based on the geological structure of the respective area. This range edges and, in a special manner, separates this south-western region of France from the country's north-eastern regions.

CONCLUSION

Basic ring structures of France, such as the Central Massif, the Paris Basin, the Armorican Massif and the Western Alps, may also be defined as ring morphostructures since they are revealed by their geological and relief features. Such relations suggest the influence of hereditary factors through neotectonic movements in the plioquaternary period.

The way in which marginal ring delineations of the Armorican Massif are integrated in the semi-ring units of the Paris Basin suggests the presence of a further, larger Armorican-Paris semi-oval complex of northern France.

In southern France predominates the Central Massif. It is in comparatively passive tectonic relation with regard to the bordering ring structural units. Contrary to this, the convex ring delineations of the Western Alps penetrate into the Central Massif.

The singling out of the individual ring structures in the relief can serve as basis for a special morphostructural division of France territory. Further investigations should be concentrated on the tectodynamic factors of this development in a chronological sense.

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Prstenaste strukture Francuske

V. Klein

Osnovne prstenaste strukture Francuske, kao što su Centralni masiv, Pariški bazen, Armorički masiv i Zapadne Alpe, mogu također biti definirane i kao prstenaste morfostrukture, pošto nisu okarakterizirane samo geološki, nego i značajkama reljefa. Takvi odnosi sugeriraju utjecaj nasljednih faktora u vrijeme neotektonskih pliokvartarnih pokreta.

Način na koji je ivični prsten ocrtao Armorički masiv, upotpunjen poluprstenaštim spojem Pariškog bazena, sugerira prisutnost daljeg, prostranijeg Armoričko-Pariškog polu-kružnog kompleksa sjeverne Francuske.

U južnoj Francuskoj preovlađuje Centralni masiv. On je u relativno pasivnom tektonskom odnosu prema graničnim prstenastim strukturnim jedinicama. Isto se ne odnosi na prstenastu strukturnu provinciju Zapadnih Alpa, jer njezini konveksni prstenasti ocrti penetriraju Centralni masiv.

Pojedinačno izdvojene individualne prstenaste strukture u reljefu mogu poslužiti kao osnova za posebnu morfostrukturnu podjelu teritorije Francuske.

Dalja istraživanja treba koncentrirati na tektodinamske faktore razvoja prstenastih struktura u kronološkom smislu.