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Kinematic analysis of the mutual position of the Cretaceous paleomagnetic poles of the European epi-Variscan and African platforms with respect to the Alpine movements in the Mediterranean Alpides

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Кинематический анализ взаимного положения меловых палеомагнетических полюсов европейской платформы и Африки с точки зрения альпийских движений в медитеранной ветке альпид

Геологическим анализом взаимного положения меловых магнитных полюсов африканской и североевропейской платформ („Африка" и „Европе стабле", Крс, 1982) уточняются размеры альпийского сближения обоих платформенных районов в течении мела, третичного и четвертичного периодов (2000—2300 км) и даётся дефиниция пространственной геометрической закономерности некоторых структур медитерранной альпийской зоны.

Kinematic analysis of the mutual position of the Cretaceous paleomagnetic poles of the European epi-Variscan and African platforms with respect to the Alpine movements in the Mediterranean Alpides

Geological analysis of the mutual position of the Cretaceous magnetic paleopoles of the African and North European platforms ("Africa" and "Europe stable", Krs, 1982) refines the dimension of the Alpine approach of the two platform regions during the Cretaceous — Quaternary interval to 2000—2300 km, and defines spatially the geometric regularities of the Mediterranean Alpine zone.

Krs (1982) has demonstrated that the Earth's magnetic field was dipolar in the geological past as it is today. Consequently, if at the present time two different images of the magnetic paleopole belong to continental platforms of "Europe stable" (i. e. the North European epi-Variscan platform) and "Africa" (i. e. the African platform) for the same geological period, it implies that the platforms had moved with respect to each other since that time. As a result of this motion, the originally common paleopole splitted into two particular images, each of which — firmly tied to one of the platforms — changed its position to the image of the same paleopole connected with the other platform.

On the basis of paleomagnetic data Krs

(op. cit.) computed the present mean paleomagnetic pole positions for both the North European epi-Variscan platform and the African platform in the Carboniferous, Permian, Triassic, Jurassic and Cretaceous periods (op. cit., p. 56—57). Although the mean paleomagnetic pole positions for periods many millions years long are only a very simplified reflection of the subsequent changes in the mutual position of the two platforms (the changes were broadly continuous), they clearly indicate that the image of the paleopole of the European platform is the more distant from the African image of the same paleopole, the longer is the time interval from the Recent (Tab. 1). This provides evidence that after the Variscan tectogenesis the two platforms shifted markedly from each other.

Analysis

The mutual motion of the two coeval images of the paleopole does not reveal much of the mutual shift of the African and North European platforms, neither of its polarity. The splitting of the originally single paleopole into two images and their removing from each other may result not only from the drifting apart of the two platforms but also from their mutual approaching or rotation, or from any combination of such processes. The relative movement of the African and North European platforms, as is registered by the pair of magnetic paleopole images for the periods given in Tab. 1, might have been thus of diverse characters.

The post-Variscan movement of the two paleopoles relative to each other can be analysed kinematically by resolving the prominent structural manifestations in the collision zone of the two platforms, generated during the post-Jurassic, i. e. Alpine orogenic period, whose structures have been preserved coherently and are generally best known. The set of compression and collision structures derived from the latest paleopole positions recorded for both the African and North European platforms by Krs (op. cit., p. 56—57, "Mean paleomagnetic pole positions — Cretaceous") represents the Mediterranean branch of the Alpides formed during Cretaceous, Tertiary up to Quaternary times. Our attention will therefore be focussed on this sector of the Alpides and on the present-day positions of the respective images of the Cretaceous magnetic paleopole for the North European and African platforms.

Another point of issue of our analysis will be the hypothesis of a permanent approximate coincidence of the magnetic axis of the Earth's dipole with the Earth's axis of rotation. According to Krs (op. cit.), this coincidence has been verified for the Tertiary, in particular.

In the Mediterranean Alpides the alpine-type compression and/or collision struc-

TAB. 1

The shortest (orthodromic) mutual distances of the images of the African and North European epi-Variscan platforms

The two images of the originally common paleopole moved away from each other during the epi-Variscan period to the following distances (based on geographical coordinates of magnetic paleopoles for "Africa" and "Europe stable", as given by Krs, 1982; Tab .1):

From the Cretaceous to the Recent	2780 km (25° angular d.)
from the Jurassic to the Recent	4060 km (36.5° angular d.)
from the Triassic to the Recent	5220 km (47° angular d.)
from the Permian to the Recent	6560 km (59° angular d.)

Calculated on spherical surface R = 6370 km, distances rounded-off.

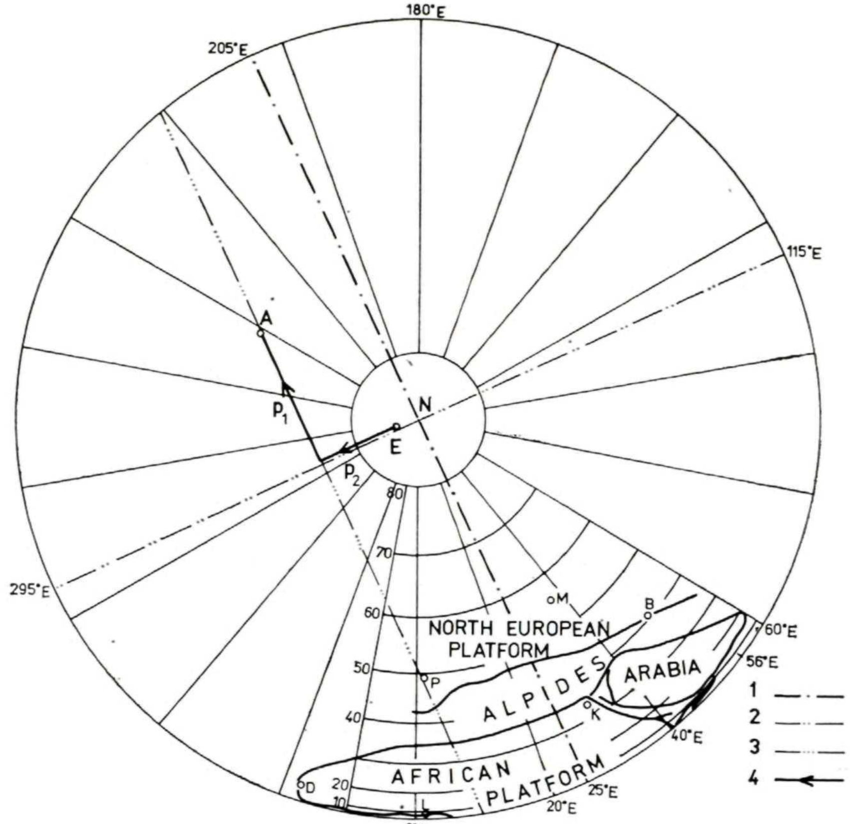

Fig. 1. Orthogonal polar projection of the northern hemisphere of the Earth showing the outlines of the African platform, the Arabian Shield and the southern margin of the North European platform. N — northern geographical pole of the Earth, A — present position of the African image of the paleomagnetic pole for the Cretaceous period (Krs, 1982), E — present position of the North European image of the paleomagnetic pole for the Cretaceous period (Krs, op. cit.), D — Dakar, L — Lagos, K — Cairo, P — Paris, M — Moscow, B — Baku, p_1 — principal component of the relative movements of the African and North European platforms in the Cretaceous, Tertiary and Quaternary, p_2 — subordinate component of the relative movements, 1 — meridian 25° E, 2 — rotational axis common to the meridian 25° E and the parallel circle (3), 3 — circle parallel to meridian 25° E drawn through pole A, 4 — components of the relative paleomagnetic pole movement

tures predominate. Despite the sectional particularities of the structure and evolution (see e. g. Krs — Roth, 1979; Roth, 1986; Stöcklin, 1984) a marked "rapprochement" of the African and North European platforms in the N—S direction during Cretaceous and Tertiary periods was evidenced by the analysis of the Alpide structure already by Argand at the beginning of this century. The modelling of this structurally dominant post-Variscan motion on a sphere surface (Fig. 1) shows that the empirical axis of the shift of the rigid African platform to the N relative to the rigid North European platform is approximately the great circle (meridian) 25° E. The direction of this axis is broadly the direction of the structurally dominant component of the mutual approach of the two platforms in Cretaceous and Tertiary times. In the course of platform shifting along the axial meridian 25° E the points of the rigid platform (as part of the spherical shell of the Earth) move along minor circles parallel to the meridian 25° E and running W or E of it. The relative shift in degrees will be the same for all points of the platform (both on and beyond the meridian). The shift length in kilometres, however, will diminish with the radii of the parallel circles to the W and E of the axial meridian (i. e. towards both the poles of rotation, common to meridian 25 °E and the parallel minor circles). On the poles of the rotational shift of the rigid platform on the sphere surface it will drop to zero. The poles of rotational shift along the axial meridian 25° E lie on the geographical equator (115° E and 295° E; Fig. 1).

The axial character of the meridian 25° E in the shift of the African platform to the N relative to Europe is evidenced by the course of alpine compression structures along the northern margin of the African platform, that is by a continuous change in the azimuth deviation (δ) of the compression trajectories from the local meridians. The alpine linear structures of the Fore-Sahara Atlasides, Creta, W. Taurus and Cyprus, as well as Zagros (in the foreland of the rather independent Arabian Shield) show a slightly arcuate course relative to the meridians (convergent to the N), convex towards Eurasia and symmetric to the meridian 25° E. This course corresponds to the geometrically conditioned increase in the divergence (both to the W and E of 25° E) of the parallel circular trajectories of the motion of the northern margin of the rigid African platform from the geographical meridians converging to the N. West of the axial meridian 25° E the trajectories of the alpine compression on its S margin diverge from local meridians westwards (Fore-Sahara Atlasides), in front of the meridian 25° E they trend to the north, east of it (incl. the complications due to gradual separation of the Arabian Shield) they diverge eastwards, to the right from the meridians (Zagros Mts.).

This geometrical regularity (i. e. dependence of the compression azimuth δ on the geographical position (λ, φ) of the site of compression relative to the axial meridian), which for N Africa confirms the aproximately axial character of the meridian 25° E (λ_0) can serve even to a more detailed mathematical analysis of the alpine compression structures. The analysis suggests a considerably independent mobility of the Arabian Shield.

The analysis of analogous spatial relations was made using the Eq.

$$\tan \delta = \tan \Delta \lambda . \sin\varphi \quad (1)$$

This formula is valid for computing the local azimuth of the compressive stress acting parallel to the meridian λ_0 at the site λ, φ. The local divergence (azimuth) of the stress trajectory (δ) from the local meridian (λ) depends on the angular distance between λ and λ_0 ($= \Delta\lambda$) and on local latitude φ. From the formula it follows that in the subpolar region ($\varphi \doteq 90°$) the divergence δ approaches $\Delta\lambda$ (Fig. 1).

In modelling the relative movements of the African and North European platforms, the shift of Africa appears to be decisive: The North European platform (according to the narrow cone of confidence for the paleopoles from the epi-Variscan period) has been declared as very stable already by Krs. Its spatial stability is also demonstrated by a relatively very small change in the paleolatitudes of the paleopole images of "Europe stable" in Cretaceous and Tertiary times, i. e. by their permanent proximity to the pole of rotation of the

Earth. The present-day latitude of the paleopole image of the North European platform for the Cretaceous period is 86.8° N, whereas the latitude of the African paleopole image is 63.1° N (Krs, op. cit.). If, as is presumed, the original common paleomagnetic pole was near the pole of Earth's rotation, the North European image of the Cretaceous paleopole has remained there until today, whereas the African image (and obviously the African platform itself) has markedly changed its position relative to the Earth's rotation axis since that period.

Using the direction of the structurally conclusive shift of Africa relative to the North European platform (i. e. the N-vergent shift of Africa, parallel to the meridian 25° E), we have resolved the mutual divergence of the African and North European images of the Cretaceous paleopole into two vectors, perpendicular to each other (Fig. 1). In this way we have arrived at these conclusions:

A. The relative movement of the two images of the Cretaceous paleopole (as well as of the two platforms) should be modelled by a shift at the sphere surface. It can be expressed (at the spherical surface) by two vectors crossing at right angles. The principal vector (p_1) is parallel to the dominant compression trajectory of the Mediterranean Alpides, i. e. to the meridian 25° E. Both images of the Cretaceous paleopole, however, lie beyond this meridian (Fig. 1). Therefore, the main component (p_1 in Fig.1) of their relative motion is plotted by an arc of the circle, which is parallel to the meridian 25° E and passes through the African image of the Cretaceous paleopole (A). The subordinate component of the relative movement of the two images (p_2) is represented by an arc of the great circle drawn through the North European image of the Cretaceous paleopole (E in Fig. 1), at right angles to the meridian 25° E. The amount of the two components (p_1 as well as p_2) can be measured either by degrees or by kilometres from each of the Cretaceous paleopole images to the intersection of the vectorial components in Fig. 1. (The dimensions of the components are approximative, because the model sphere does not precisely reproduce the shape of the Earth.)

The p_2 component can be modelled as nearly corresponding to a section of the meridian 295° E, which is perpendicular to the meridian 25° E (the North European Cretaceous paleopole position being 293.2° E and 86.8° N, i. e. next to the present-day northern pole of Earth's rotation, see Fig. 1).

B. The Cretaceous paleopole of the African platform (A in Fig. 1) is situated (in the direction of the main movement component p_1) pronouncedly beyond the Cretaceous paleopole of the North European platform (E, Fig. 1). This confirms the post-Jurassic approach (and Alpine collision) of the two platforms. From the position of the Cretaceous paleopole of the North European platform in the proximity of the northern Earth's pole (where it remained also in the Tertiary, Krs., op. cit., Tab. 1) it can be asserted that the African platform approached to the very stable N. European platform at that time by shifting parallel to the meridian 25° E.

C. Whereas the total orthodromic distance between the African and North European images of the Cretaceous paleopole is at the present time c. 2780 km, i. e. 25° angular distance (see Tab. 1), the main component of the movement (perpendicular to the compression structures of the Mediterranean Alpides) measured along the circle parallel to the meridian 25° E amounts to c. 2120 km (20.8° angular distance, p_1 in Fig. 1). This component of the post-Cretaceous removal of the African image of the Cretaceous paleopole from its North European image illustrates the main structure-forming approach of the African platform to the North European platform since Cretaceous times.

D. The Cretaceous paleopole of Africa (A in Fig. 1) is, relative to the Cretaceous paleopole of the North European platform (E in Fig. 1), shifted from the principal movement component *(p_1)* by about 12.3° angular distance (1370 km) to the left. The relation of this subordinate component of the post-Cretaceous removal of the Cretaceous paleopole images from each other (p_2 in Fig. 1) to the total movement of the platforms is less definite than the relation of the principal component p_1. It will be discussed in the further text.

E. The principal component of the shift of the African platform relative to the North European platform *(p_1)*, measured as the angular distance of paleopole images (20.8°) is valid over the whole length of the Mediterranean Alpides. The "rapprochement" of the two platforms in km, however, is maximum on the axial meridian 25° E (2310 km), decreasing to the poles of rotational shift, both west- and eastwards. In the western Mediterranean region it may amount to only 2000 km. In the sector of the Alps, where the Adriatic projection of the African platform (Channell — Horváth, 1976), caused the maximum compression, the total Cretaceous — Tertiary N—S approach of the present-day platforms is estimated at 2250 km.

The approach *(a)* of two points at the surface of a model sphere lying on a circle parallel to the axial meridian λ_0, one of which has a geogr. longitude λ, effected by shift parallel to the axial meridian by $\alpha°$ can be assessed (km) using the Eq.

$$a = 111.2\ \pi \cos \Delta\lambda \, . \, \alpha \qquad (2),$$

where $\Delta\lambda$ is the angular difference between λ and λ_0.

The component p_2 of the relative movement of the paleopoles

Whereas the North European platform building up the European continent between the Atlantic Ocean and the Ural Mts., north of the Alpides, has preserved (as stated above) a fairly stable position relative to the Earth's axis of rotation since the Cretaceous period, the African platform was more mobile to both the North European platform and the Earth's axis of rotation during this period. A predominance of the African platform movement can thus be expected as in p_1 so in p_2 component. The component p_2 (in polar region — Fig. 1) might have originated by a relative shift and/or by rotation of both platforms relative to each other. The centre of rotation of Africa relative to Europe might have existed within or outside either of the platforms: the rotation might have been sinistral or dextral. The position of the paleopoles discussed (A, E in Fig. 1), which are far beyond both the platforms, can essentially distort the amount of component p_2 in our case.

A substantial portion of the component p_2 may be ascribed to the post-Cretaceous sinistral rotation of Africa, which was inferred by Krs (1982, p. 65) from the divergence of the Jurassic and Cretaceous paleomeridians from the geographical meridians (without stating its amount).

The principal component of the relative motion of the African and North European images of the Cretaceous paleopole (p_1 in Fig. 1), which is based on the structural manifestation of this motion within the Mediterranean branch of the Alpides, is more strictly defined in direction and size than the subordinate component *(p_2)* derived from it. It is structurally evident in the collision zone of the two platforms at the contact of the African and Eurasian lithospheric plates. Its major importance is also demonstrated by the fact that its size approaches the orthodromic (the shortest spherical) distance (Tab. 1) between the two images (A, E in Fig. 1) of the Cretaceous paleopole. The structural manifestations of the p_2 component (acting in the direction of the meridian 115° E, Fig. 1) and of the resultant of p_1 and p_2 components combined have still to be investigated. (In Fig. 1 the line connecting A with E corresponds to this resultant; meridian 56° E acting as the axis of such a shift is parallel to it.)

Whereas the component p_1 arises from the African lithospheric plate (the axis of shift of the African platform is the meridian 25° E, forming the longitudinal axis of Africa), the co-existence of p_2 component in the drift of the African platform suggests compressive stresses to be translated onto it from the Arabian, Somalian and Indian lithospheric plates. In the polar region (Fig. 1) the dimension of the subordinate component p_2 is relatively great but fictitious; it amounts to an angular distance of 12.3°, which makes 59 % of the p_1 effect. The actual effect of p_2, i. e. the shift of the African platform in km on the surface of the reference sphere (parallel to the axial meridian 115° E) however cannot be very great. The axial meridian of p_2 (115° E) runs outside Africa (Fig. 1), but the pole of the shift parallel to the meridian 115° E lies on the equator (25° E) in the centre of Africa; according to Eq. (2) the km-amount of the shift decreases to this pole gradually from the axial meridian up to zero. As a result, the component p_2 could have manifested itself as a compressive stress chiefly in NE Africa and in the eastern part of the Mediterranean Alpides, where its effect (due to its direction given by Eq. 1) combines with that of p_1. (In contrast, in the NW of the African platform the component p_2 gradually acts against the component p_1, which eliminates it.)

The following processes have to be regarded as kinematic manifestations of the component p_2: (a) the post-Cretaceous sinistral rotation of Africa, as assessed by Krs (probably round the pole lying near the equator in the Congo basin at 25° E); (b) gradual separation of the Arabian Shield from the African platform (with simultaneous generation of the Arabian lithospheric plate) accompanied by shifting towards the NW and sinistral rotation of the Shield; and (c) a much more advanced separation of the Hindustan Shield of ancient Gondwana and the Indian lithospheric plate. A structural manifestation of the component p_2 is presumably the East African rift system at the eastern margin of the African platform. Lying in the N-vergent branch of the p_2 rotation shift, this system turns about the Congo rotation pole from the N—S strike on the equator to the SE—NW trend in the Red Sea. Towards the NW it passes from the dilation structures into shear and compression structures in the zone of the Alpides of the central and eastern Mediterranean regions. The dependence of several of these structures on the shift parallel to meridians between 56° E and 115° E can be demonstrated by the geometrical analysis expresed in Eq. (1). For example, the Vardar lineament in Greece and Jugoslavia is evidently parallel to the axial meridian 56° E, whose direction coincides with that of the resultant of p_1 and p_2 components (Fig. 1).

The compressive stress of the component p_2 in the northern foreland of the Alpides (within the North European platform) probably led also to the Saxon revival of the ancient structure of the Sudetic trend.

Conclusion

Whereas the present-day mean width of

the Mediterranean Alpine zone is about 1200 km, the width of the zone that corresponded to it at the beginning of the Cretaceous period was on the average 3200—3500 km, i. e. 31° of angular distance. At that time this zone was of course built up to a great extent of the margins (as yet little disrupted) of the two neigbouring epi-Variscan platforms. These margins were annexed to the Alpides by the Late Cretaceous and Tertiary alpine tectogenesis. Zones of oceanic character surviving into the Early Cretaceous were relatively narrow.

The Cretaceous period involves the time interval of 144 to 65 Ma. It was markedly longer (79 Ma) than the following Tertiary — Quaternary period (65 Ma). The middle interval of the Cretaceous period corresponds to the later Albian, when the alpine reconstruction of the Mediterranean zone involving the closure of quasi-oceanic and oceanic zones, and the collision of the platforms set on. From Tab. 1 it may be inferred that at least since the Permian the approach of the African platform to the North European platform was very continuous. The mean rate of rapprochement of the two platforms (according to the motion of coeval paleopole images) has been about 24.6 mm/yr since the Permian until today, c. 22.6 mm/yr since the Triassic, c. 22.7 mm/yr since the Jurassic, and c. 26.6 mm/yr since the Cretaceous up to the present time.

The analysis has revealed that the post-Jurassic shift of the African platform (as a constituent part of the African lithospheric plate) had a northward trend and was more active relative to the rather stable North European platform (as part of the Eurasian lithospheric plate). From the geometry of the alpine compression trajectories at the northern margin of the rigid African platform it can be inferred that the axis of the alpine drift of the present-day African platform to the N was (approximately) the meridian 25 ° E. During the Cretaceous, Tertiary and Quaternary periods the approach to the North European platform at this meridian attained about 2300 km. The rapprochement of the two present platforms decreased westwards to some 2000 km (in the western Mediterranean region). In the E it was influenced by the lateral motion component (p_2).

The amount of the lateral, subordinate motion component (p_2 in Fig. 1) cannot be defined accurately. For example, the amount of the post-Cretaceous sinistral rotation of Africa (recorded by Krs, op. cit.), which this component likely provoked, has not been determined. This partial rotation and structural effects of p_2, above all the East African-Red Sea Rift System, are a result of the compression stress entering the NE part of the African platform (and the Mediterranean Alpide zone) from the Arabian and Indian lithospheric plates. The direction of the resultant of these stresses and trajectories of structural movements probably oscillated between 56° E and 115° E (see Fig. 1). The effects of these lateral stresses produced by p_2 component also involved the separation of the Hindustan and Arabian Shields from the African platform and the origin of the Arabian, Somalian and Indian lithospheric plates. As can be demonstrated by a mathematic-geometrical consideration, many of the middle and eastern Mediterranean shear structures of the SE—NW strikes (the Apennines, Dinarides, the Vardar and North Anatolian lineaments) reveal the influence of the lateral p_2 component. Similar structures could not have originated in the western Mediterranean region.

The paper presents a summary picture of the Cretaceous and Tertiary alpine movements in the Mediterranean branch of the Alpides, in respecting the approximately spherical shape of the Earth. It is based on the analysis of the present-day positions of the two images of the Cretaceous magnetic paleopole ("Africa" and "Europe stable"), as obtained statistically by Krs. The results have shown that the earlier cautious estimates of the reduction of the width of the Mediterranean Alpide zone, presented by a number of authors on the basis of other, mostly geological data, agree with the present view as concerns the order of magnitude. The structure-forming shift of the African platform to the N seems to be commeasurable with the analogous shift of the Hindustan platform relative to the Siberian platform.

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Kinematický rozbor vzájemné polohy křídových paleomagnetických pólů evropské epivariské platformy a Afriky z hlediska alpínskych pohybů v mediteránní větvi alpid

Geologický rozbor nynější vzájemné polohy magnetických paleopólů severoevropské a africké platformy („Europe stable“ a „Africa“; Krs, 1982) pro období křídy vyvozuje kolizi obou platforem, při níž vznikala mediteránní větev alpid, a umožňuje na základě moderně zpracovaných paleomagnetických dat (Krs, l. c.) v širším rámci diskutovat její rozměry a trojrozměrnou kinematiku.

Patří-li pro totéž období geologické minulosti k africké a severoevropské platformě dva různé obrazy téhož paleopólu, je to důkaz pozdějšího vzájemného pohybu platforem, kterým byl (původně jednotný) paleopól rozdělen na dva obrazy. Tab. 1 dokládá vzájemný pohyb platforem růstem vzájemné vzdálenosti afrických a severoevropských obrazů paleopólu z období permu, triasu, jury a křídy. K dělení původně jednotného paleopólu na dva obrazy (vždy pevně spojené s jednou z platforem) dochází obecně při každém pohybu platforem, i při jejich kolizi.

Východiskem rozboru je celková orientace alpínské kolizní zóny. Divergence mezi trajektoriemi alpínské komprese a místními poledníky na nynějším s. okraji africké platformy narůstá symetricky od poledníku 25° E k západu i k východu. To dokládá, že tento poledník je (přibližně) osou sunutí africké platformy vůči Evropě. Rozbor polohy paleomagnetických pólů Afriky a severoevropské platformy v období křídy a terciéru naznačuje (jak potvrdila i povaha paleomagnetických dat; Krs, l. c.), že severoevropský paleopól zůstával od křídy v blízkosti rotačního pólu Země a změny ve vzájemné poloze obou paleopólů i vznik kolizní struktury alpid byly vyvolány aktivním posunem africké platformy k S, rovnoběžným s osním poledníkem 25° E. Africký obraz křídového paleopólu se posunem Afriky k S vůči Evropě ocitl daleko za severoevropským obrazem (ve směru s poledníkem 25° E rovnoběžném — hlavní složka pohybu p_1, obr. 1).

Vedlejší složka pohybu křídového paleopólu africké platformy (p_2, obr. 1) je společným projevem sinistrálního pootáčení Afriky (Krs, l. c.) a vzniku terciérních střižných struktur směru JV—SZ až V—Z ve v. Středomoří. Z prostorově geometrických důvodů, které jsou v článku vyloženy, se tato vedlejší pohybová složka v z. Středomoří strukturně neuplatňovala. Podle osních směrů rovnoběžných s poledníkem 115° E se na vzniku této složky podílela tlaková napětí přenášená z tichomořských alpid, a to většinou ve vektorovém součtu se severovergentním pohybem hindustánského a osamostatňujícího se arabského štítu (směr výslednice AE rovnoběžný s poledníkem 56° E, obr. 1).

Činí-li průměrná šířka mediteránní alpínské zóny nyní asi 1200 km, byla zóna, které svým nynějším obsahem alpidy odpovídají, počátkem křídy široká průměrně 3200—3500 km, tj. 31° oblouk. Tuto zónu tehdy většinou tvořily široké okraje sousedních platforem. Ve spodní křídě je vzájemně oddělovala zbytková předkolizní eugeosynklinální zóna. Při svrchnokřídové a terciérní tektogenezi byly okraje platforem alpidami anektovány. Průměrná rychlost vzájemného sbližování nynější africké a severoevropské platformní oblasti kolísala (podle dat Krse, l. c.) v povariském období v mezích 22,6—26,6 mm za rok.

ZO ŽIVOTA SPOLOČNOSTI

Z. Pouba: **Zlato v horninách Českého masívu a jeho ekonomické koncentrace.** (Bratislava 30. 10. 1985)

Ke stanovení prognóz Au v Českém masívu byly chemicky testovány základní typy hornin všech geologických jednotek a souvislý travers protínající jádro masívu od boskovické brázdy po mariánskolázeňský komplex. Bylo zjištěno, že nejvyšší obsahy zlata jsou v horninách proterozoického stáří, a to především v horninách biogenních, vulkanických a vulkanosedimentárních. Nejnižší obsahy byly zjištěny v horninách paleozoických v Barrandienu a v krystalinickém jádru — v moldanubiku v granitoidech. Mezi proterozoickými horninami vyšší obsahy zlata mají bazické horniny primitivního chemismu a horniny bimodálních pásem typu greenstone belt. Mezi nimi nejbohatší je jílovské pásmo (Čelina — Mokrsko) a šumavská část pestré série moldanubika (Kašperské Hory). V obou případech je zlato v horninách doprovázeno wolframem, který se někdy koncentruje v scheelitových stratiformách.

Zlato ve vulkanosedimentárních formacích proterozoika, i když je zřejmě mobilizované granity nebo metamorfózou, má vysokou ryzost. Zlato z hydrotermálně postižených hornin nebo z hydrotermálních ložisek má ryzost podstatně nižší. Na žilných ložiskách polymetalů, kde zlato tvoří doprovodnou složku, je zastoupeno elektrem. V Jeseníkách je část zlata asi naložena na vulkanosedimentární stratiformní mineralizace (Zlaté Hory) a část se vyskytuje v „černých břidlicích" (Suchá Rudná).

Hlavním zdrojem monovalentního zlata jsou zřejmě primitivní bazické horniny Českého masívu. Ke koncentraci zlata ve formě trivalentní dochází zřejmě až následnými procesy metamorfózy a granitizace, vyvolávající hydrotermální aktivitu.