GEOLOŠKI VJESNIK	Vol. 43	str. 53–58	Zagreb, 1990.

UDK 551.248.2 *Izvorni znanstveni članak*

Kinematika neotektonskih deformacija na području srednjeg toka rijeke Neretve

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Ključne riječi: Neretva, neotektonika, kinematika

Na temelju vektora kretanja, utvrđen je model kinematike deformiranja pod djelovanjem neotektonskih pokreta. Otvoreno je pitanje, u kojoj se mjeri ovi specifični strukturni oblici mogu prepoznati kao neposredni produkti neotektonske aktivnosti na prostoru Vanjskih Dinarida

Key words: The river Neretva, neotectonics, kinematics

As a basis to determine the deformation kinematics model under the impact of neotectonic movements served the movement vector. The question of to what extent these specific structural forms can be recognized as being direct products of neotectonic activity within the area of auter Dinarics remains however open.

Uvod

Istraživano se područje prostire od naselja Salakovac do naselja Mandići, između padina planina Čabulje i Prenja, oko 15 km sjeverno od Mostara. Teren se ističe do 600 m dubokim, strmim kanjonom rijeke Neretve i morfološki vrlo razvedenim pribrežjem lijeve i desne obale rijeke. Izgrađuju ga naslage karbonatne platforme; malmske, donjokredne i gornjokredne starosti, te oligocenska flišolika formacija lapora i pješčenjaka.

Stupanj tektonske poremećenosti sedimentnog sklopa, najizrazitije ocrtava nenormalni kontakt oligocenske formacije sa starijim naslagama. Slične tektonske odnose indicira i položaj donjemiocenskih jezerskih sedimenata Bijelog polja blizu Salakovca (Mojičević & Laušević, 1973). Može se zaključiti da je ovo područje nakon donjeg miocena zahvaćeno tektonskim pokretima koji su proizveli i specifični strukturni sklop bora, ljusaka i reverznih rasjeda, približnog pružanja istok-zapad.

Vrijeme početka ovih tektonskih pokreta i njihov strukturni tip deformiranja, podudara se s promjenom smjera kretanja Afričke ploče prema sjeveru, uslijed čega se i Jadranska platforma podvlači u istom smjeru pod Vanjske Dinaride (Prelogović & Kranjec, 1983; Aljinović, 1984). Ova se promjena smjera očituje kinematski, kao globalni tangencijalni stres koji djeluje na pravcu jug-sjever.

Novi stres preborava zatečene, odnosno stvara nove kinematski specifične deformacije po kojima se i aktivnost ovih pokreta može pratiti od miocena do danas (neotektonski pokreti u užem smislu).

U ovom je prikazu namjerno izostavljen uobičajeni standardni način grafičkog označavanja reverznog rasjeda kao i čela ljuske ili navlake, jer se po sili navike, za svaki takav slučaj očekuje i inverzni slijed naslaga. Zbog toga se prišlo isključivo oznakama vektora kretanja.

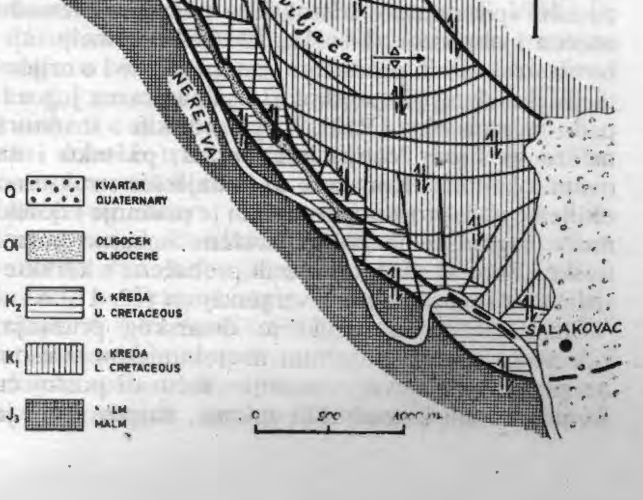
Također se upotrebljava izraz »desno reverzno kretanje« (po Usov-u i Maločanov-u, +–) zbog razlikovanja od striktno perpendikularnog »reverznog kretanja« (+0).

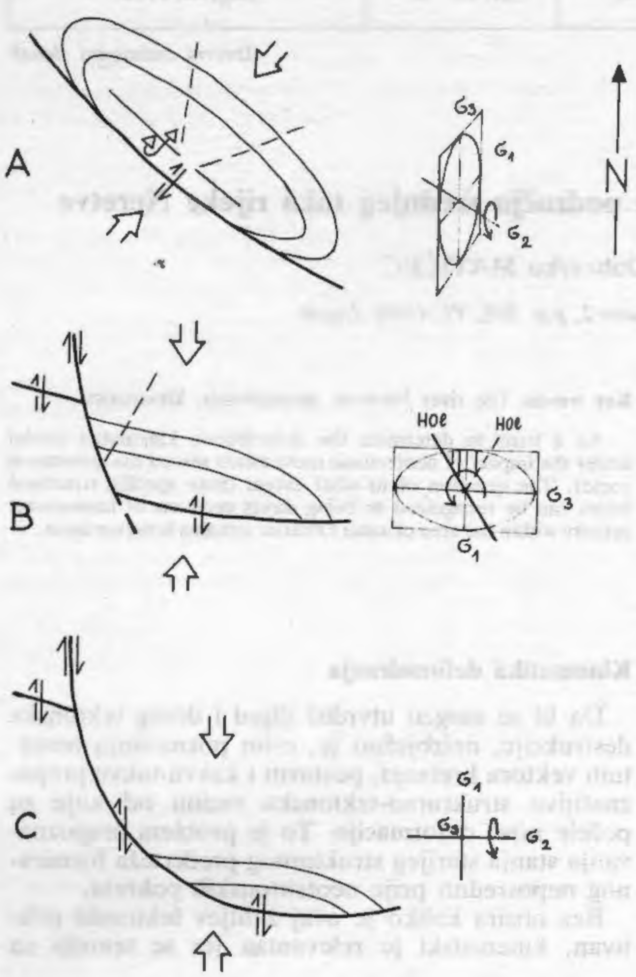
Kinematika deformiranja

Da bi se mogao utvrditi slijed i doseg tektonske destrukcije, neizbježno je, osim poznavanja recentnih vektora kretanja, postaviti i kakvu-takvu prepoznatljivu strukturno-tektonsku razinu od koje su počele nove deformacije. To je problem prepoznavanja stanja starijeg strukturnog predcrteža formiranog neposredno prije neotektonskih pokreta.

Bez obzira koliko je ovaj zahtjev tektonski relativan, kinematski je relevantan jer se temelji na

PREGLEDNA GEOLOŠKA KARTA SREDNJEG TOKA RIJEKE NERETVE
Geological survey map of the river Neretva middle water course





Sl. 1 A, Pirenejske deformacije.
B, Neotektonska retrogradna rotacija
C, Neotektonsko navlačenje.

Fig. 1 A, Pyreenean deformations.
B, Neotectonic retrograde rotation.
C, Neotectonic overthrusting.

oblikovanju i orijentaciji glavnih strukturnih formi koje su neposredni izraz smisla djelovanja predneotektonskog stresa. Ili, bolje rečeno, temelje se na prepoznavanju deformacija sukladnih s očekivanim fiziografskim svojstvima struktura koje je mogao proizvesti specifični predneotektonski stres. To su strukture »dinarskog pravca pružanja« (sjeverozapad – jugoistok) koje su nastale pod djelovanjem tangencijskih »pirenejskih tektonskih pokreta«, između eocena i oligocena (Stille, 1944). Na temelju njihovih strukturnih produkata, zaključuje se i o orijentaciji globalnog pirenejskog stresa na pravcu jugozapad–sjeveroistok. Relikti pirenejskih struktura nalaze se širom Vanjskih Dinarida, pa tako i na ovom lokalitetu. Konačno, to je najčešće strukturno obilježje ovih prostora, po kojem je pružanje i dobilo naziv. Izgrađuju ih dobro izražene linearne bore i ljuske. Bore su obično kose ili prebačene s karakterističnom jugozapadnom vergencijom (Sl. 1., A).

Stare pirenejske strukture dinarskog pružanja, zahvaćene novim globalnim neotektonskim stresom na pravcu jug–sjever, »nastoje« sačuvati postojeću formu. Po sili kinematskih zakona, najpovoljniji je način održavanja interne geometrije sklopa, »postavljanje« forme u položaj koji se najuspješnije opire novom deformiranju, dakle »postavljanje« strukture normalno na novi stres. Zbog toga strukture najkraćim putem rotiraju prema položaju pružanja istok–zapad i to u lijevo (retrogradno) oko subvertikalne osi srednjeg stresa – σ_2 (Sl. 1, B).

Prostor rotaciji ostvaruje se bočnim oslobađanjem napetosti po velikim transkurentnim rasjedima desnog horizontalnog kretanja. Budući da se desni transkurentni rasjedi, po kinematskom tipu nalaze u smičnoj HOI zoni, s njima se često pojavljuju i sinkroni HOI rasjedi lijevog horizontalnog kretanja. Zajedno tvore konjugirane parove koji zatvaraju tzv. »dihedralni kut« (Sl. 1, B).

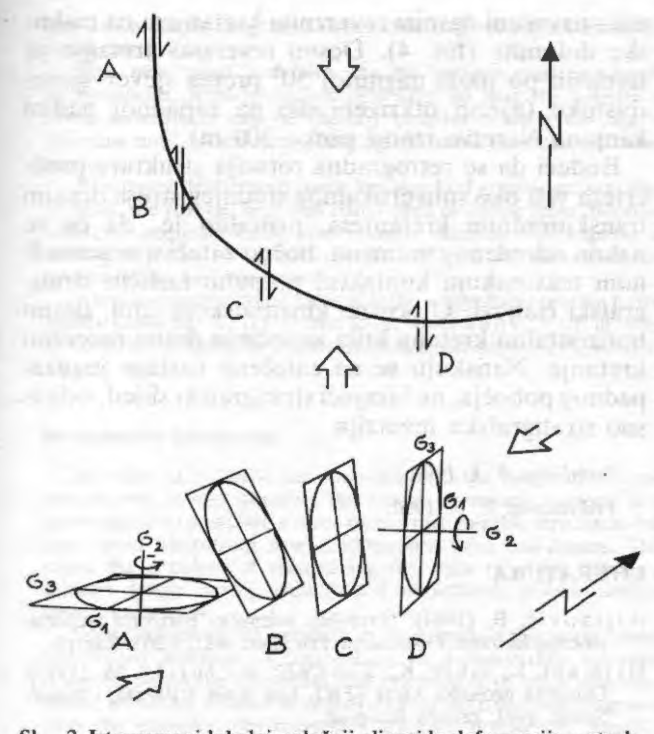
Ovaj kinematski čin neposredno prati i otvaranje velikih zjapećih, nezapunjenih tenzijskih pukotina, paralelnih s pravcem globalnog stresa.

Globalni je stres u tektonski aktivnom razdoblju stalne orijentacije (jug-sjever) i jedini je uzrok kontrakcije. Zbog toga, bilo koja točka u strukturi ima istu orijentaciju najjačeg stresa (σ_1). Ovisno o lokalnom kinematskom stanju, vrijednosti će međusobno mijenjati samo srednji (σ_2) i najmanji stres (σ_3).

U području deformiranja retrogradnom rotacijom, ove promjene imaju usmjereni porast kontroliran napredovanjem deformiranja strukture, prema položaju normalnog pružanja (istok–zapad) na globalni stres. Kako destrukcija pirenejskog predcrteža počinje retrogradnom rotacijom, oko subvertikalnog srednjeg stresa – σ_2 (Sl. 2, A), napredovanjem kinematskog razvoja, os srednjeg stresa (σ_2) sve se više naginje i »pada« prema horizontalnom položaju (Sl. 1), ali pritom zadržava isti smisao rotacije. Tako se početna retrogradna rotacija, u krajnjem kinematskom stadiju iskazuje kao rotacija prema jugu (Sl. 2, D). Strukture zauzimaju položaj pružanja istok–zapad (»hvarsko pružanje«), pa počinje puni izraz tangencijalnih neotektonskih kretanja – reverzno natiskivanje i navlačenje prema jugu.

Treba napomenuti, da su sva ova kinematska stanja (Sl. 2) samo okupljeni prikaz različitih načina kretanja geometrijskih točaka strukture pod specifičnim naponom. Njihova je kinematska razina za svaki primjerak potpuno interna, pa ih je iluzorno neposredno povezivati. Svi se ovi stadiji zasnivaju na realnim podacima kinematskih položaja i realni su odraz stanja strukturne deformacije. Međutim, sve se ove faze događaju istovremeno ali na različitim mjestima neke osnovne strukture; u mjeri lokalnog strukturno–kinematskog položaja.

U općem primjeru neotektonske deformacije, zapadno je krilo desnog transkurentnog rasjeda »bočni korjen« navlačne strukture. Ima približno pružanje sjever–jug, vertikalnu plohu i desne horizontalne vektore kretanja (fot. 1). To je područje gdje se vrši retrogradna rotacija (Sl. 2, A). U zoni gdje je pružanje rasjeda sjeverozapad–jugoistok, rasjed je desnim reverznim kretanje nagnut prema sjeveroistoku (Sl. 2, B, C, fot. 2, 3). A u području gdje rasjed ima približno »hvarsko pružanje«, (istok–zapad), vektori kretanja imaju perpendikularni smisao pravog reverznog kretanja po srednje nagnutoj plohi prema sjeveru (Sl. 2, D).



Sl. 2 Istovremeni lokalni položaji elipsoida deformacije u strukturi pod djelovanjem globalnog neotektonskog stresa.

Fig. 2 Simultaneous local positions of the ellipsoid of deforamtion under the action of global neotectonic stress.

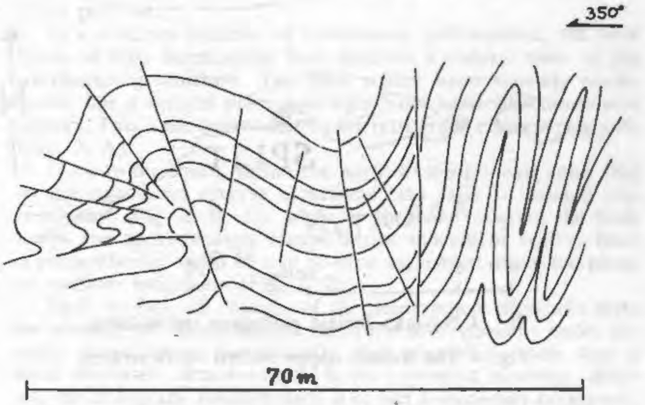
Tako, zapravo sve promjene stanja elipsoida deformacije, samo ocrtavaju geometriju strukturne forme pod istim globalnim stresom. Zbog toga ostaju lokalni kinematski izraz u najužem smislu riječi. Na koncu, i retrogradna je rotacija ustvari sekundarna pojava prouzrokovana globalnim neotektonskim stresom, pri deformiranju specifične regionalne strukture.

* * *

U istočnim padinama kanjona Neretve, na prostoru strukturne jedinice »Koviljača«, često se nalaze dekametarske bore koje imaju neočekivanu sjevernu vergenciju. Istovremeno, velike hektametarske bore iste strukturne jedinice, imaju južnu vergenciju i niski indeks stisnutosti, dok su bore sjeverne vergencije jako sabijene. Karakteristično je, da bore sa sjevernom vergencijom iskazuju i blago rasipanje osi, a kad su u setu bliskih paralelnih bora često se pojavljuju obje vergencije (sjeverna i južna) različite vrijednosti nagiba (Sl. 3).

Ova se ukupna svojstva teško mogu neposredno povezati s djelovanjem globalnog tangencijalnog stresa. Po svemu sudeći nastali su kao sekundarni produkti prevage gravitacijskog nad tangencijalnim stresom. Odnosno, mogli su nastati u fazama relaksacije, gravitacijskim kliženjem bora primarne južne vergencije i konstantne orijentacije osi (istok–zapad), mehanizmom koji podsjeća na fenomen tzv. »Hansen – plota« (H a n s e n, 1971, 27–51).

Mehaničku osnovu za ovaj tip deformiranja, eksponira strukturno-morfološki položaj jedinice »Koviljača«. Naime, osnovnu fiziografiju ove jedinice, uz brdo Pometenik uokviruje njezin desni transkurentni rasjed koji se nalazi na 220 m nadmorske visine. Oko 4 km južnije, ova se kontinuirana tektonska ploha nalazi kao desni reverzni rasjed, na 80 m nadmorske visine. U oba se slučaja, uz regionalni rasjed nalaze identični strukturno–stratigrafski odnosi, što dozvoljava procjenu da je cijeli strukturni plan jedinice »Koviljača«, nagnut za $3{,}5^0$ prema jugu. Do kliženja je moglo doći po nekom dubljem nivou, hidrostatskim tlakom povećanog stanja plasticiteta naslaga.



Sl. 3 Sjeverna vergencija bore nastala gravitacijskim kliženjem. (Vapnenci d. krede uz cestu Mostar – Jablanica).

Fig. 3 The northen vergency of fold formed by gravitational sliding. (Lower Cretaceous limestones along the Mostar – Jablanica road.)

Diskusija

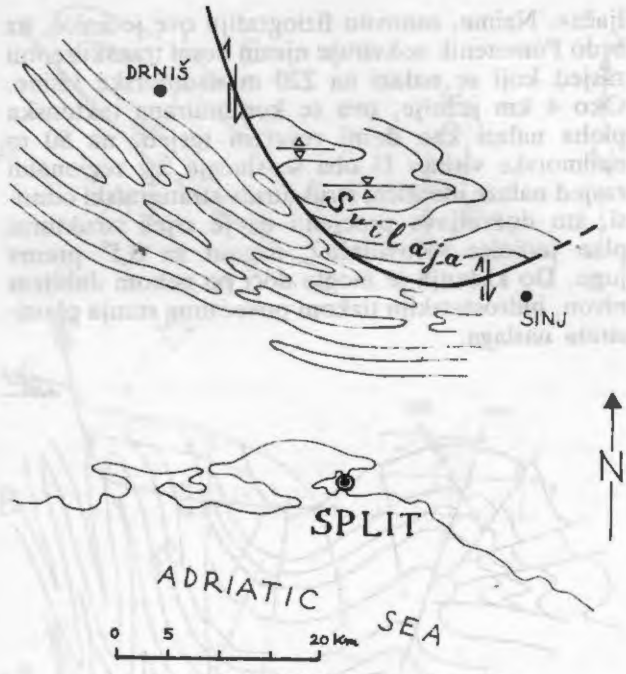
Prirodno je pretpostaviti, da ovakva neotektonska kinematika deformiranja, nije tek poseban slučaj područja srednjeg toka rijeke Neretve.

U Vanjskim Dinaridima je česta pojava »hvarskog pružanja« i njegova bliska strukturna veza s desnim transkurentnim rasjedima, kao i tektonski odnos s mlađim naslagama (oligocen, miocen). I ovo istraženo područje mali je segment zapadnog dijela navlake Prenj, ali je po svemu sudeći (M o j i č e v i ć & L a u č e v i ć 1973) suštinska regionalna osobina sklopa Prenj – Čvrsnica.

Na sličnu strukturno-tektonsku prirodu sklopa, ukazuje i navlaka Plano–Svilaja (G r i m a n i et al. 1975; I v a n o v i ć et. al. 1978; P a p e š et al. 1984). I ovdje se pod čelom navlake Svilaja (selo Neorić) nalaze oligocenske naslage (P a p e š et al. 1984).

Na svim dosadašnjim geološkim kartama, navlaka Svilaje u bitnim crtama oslikava identičnu kinematiku deformacije (Sl. 1, C). Intervenciju vrše Š i k i ć (1964) i K o m a t i n a (1968). Oni konstrukcijom protežu duboki transkurentni rasjed koji »presjeca čitavu kamenu koru«, pa i splitski fliški sinklinorij. Kod prvog autora je to »Kninski rasjed«, a kod drugog rasjed »Butišnice«. Zanimljivo je da kasnije, u nedostatku materijalnih dokaza, Š i k i ć (1976) skraćuje ovaj rasjed i ne proteže ga dalje od navlake Svilaje. A i V i d o v i ć (1970) izražava mišljenje da su ti horizontalni rasjedi »epidermalnog karaktera«.

Treba reći, da desni transkurentni, odnosno desni reverzni rasjedi, nisu presjekli postojeće navlake.



Sl. 4 Navlaka Svilaje prikazana izostratama.
Fig. 4 The Svilaja nappe shown by isostrates.

Oni su integralni konstitucijski dio navlake, pa su duboki koliko i navlaka, te ne postoje izvan njezine ukupne prostorne forme (Sl. 4).

* * *

Posebnu pažnju i obrazloženje nameće jedna, ne baš rijetka pojava strukturnih odnosa neotektonskog sklopa. To je pojava reverzno natisnutih mladih slojeva na starije. Nesporazumi u tumačenju nastaju zbog toga, što se po navici reproducira povjesni začetak prepoznavanja tektonskih odnosa, zasnovan isključivo na stratigrafskoj analizi odnosa naslaga. Ako je prekinuti slijed naslaga inverzan, u tom se slučaju govori o reverznom rasjedu, dok se nedostatak inverzije slojeva, redovito tumači gravitacijski spuštenim krilom s mlađim slojevima.

Međutim, neposredno opažanje vektora tektonskih kretanja, na primjeru brda Pometenik (704 m), ukazuje da su albsko–cenomanski vapnenci Pometenika navučeni desnim reverznim kretanjem na malmske dolomite (fot. 4). Desno reverzno kretanje je izvršeno po plohi nagnutoj 50^0 prema sjever–sjeveroistoku (njezin otkriveni dio na zapadnoj padini kanjona Neretve iznosi preko 300 m).

Budući da se retrogradna rotacija struktura predcrteža vrši oko subvertikalnog srednjeg stresa desnim transkurentnim kretanjem, prirodno je, da će se nakon određenog vremena, bočno zateći u neposrednom tektonskom kontaktu, potpuno različiti stratigrafski članovi. U novom kinematskom činu, desno horizontalno kretana krila započinju desno reverzno kretanje. Natiskuju se na zatečene naslage jugozapadnog pobočja, ne birajući stratigrafski slijed, odnosno stratigrafsku inverziju.

Primljeno: 8. I. 1990.
Prihvaćeno: 7. V. 1990.

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Kinematics of neotectonic deformations along the Neretva river middle course

S. Marinčić and D. Matičec

Introduction

The are which had been investigated stretches from the village Salakovac to the village Mandići, between slopes of Čabulja and Prenj mountains, approximately 15 km due north of Mostar. The main terrain feature present the Neretva river canyon, down to 600 m deep, together with morphologically very indented left and right riparian sides of the river. These are made of carbonate platform deposits pertaining to Malmic, Lower Cretaceous and Upper Cretaceous ages, accompanied with the Oligocenous, flysh-like marl and sandstone formation.

The degree of tectonic disturbance can be best illustrated by an abnormal contact between the Oligocene formation and older deposits. Similar tectonic relationships are as well indicated by the position of Lower Miocene lacustrine sediments at Bijelo Polje near Salakovac (Mojičević & Laušević, 1973). It can be therefore inferred that the area had been affected by strong tectonic movements in the period following Lower Miocene, creating a system of shells and reverse faults, striking approximately east-west.

The time when these tectonic movements had begun, as well as their structural type of deforamtion, coincide with the change in the African Shield movement towards north, causing at the same time the Adriatic Platform subduction in same direction, resp. underneath outer Dinarids (Prelogović, Kranjec, 1983; Aljinović, 1984). This change of direction manifests itself as a global tangential stress, directing its impact along the south-north line.

This new stress overfolds the on-the-spot existing specific deformations, namely creates new ones so that the activity of these movements can be thereby monitored since the age of Miocene until present time, bearing the name »neotectonic movements«.

This paper deliberately omits the standard graphic presentation of both, the reverse fault and either shell or nappe faces, because, after the acquired habit, one in such cases as well expects an inverse sequence of deposits. For this reason, only the movement vector marks had been used.

Another expression being used is the »right-hand reverse movement« (after M. A, Usov and I. A, Milčanov, + –), in order to be different from the strictly perpendicular »reverse movement« (+ –).

Deformation kinematics

In order to establish the sequence and the range of tectonic movements, beside konwing the recent movement vectors, it is unavoidable to postulate a more or less recognizable structural-tectonic level wherefrom new deformations have had begun. This poses the problem of recognizing the state of older structural primary design, having been formed immediately prior to neotectonic movements.

Notwithstanding the question of how much is this requirement tectonically relevant, it happens to be kinematically relevant, being based on the formation and orientation of main structural forms, which are a direct demonstration of deformations congruent with the expected physiographic structure properties, possibily created by the specific neotectonic stress. These are structures having the »Dinaric Direction of Strike« (notrh-west/south-east), having been created under the action of tangential »Pyreenean Tectonic Movements« between Eocene and Oligocene. Such orientation is also confirmed by more recent geophysical opinions about changes in the African Shield direction of movement, which, since the end of Paleogene, gradually changes from the north-east direction to the northward one (Prelogović & Kranjec, 1983; Aljinović, 1984).

This is the extent, although not in an intact state, to which relicts of Pyreenean structures can be found throughout outer Dinarids and, consequently, within this locality. After all, this is the most common structural feature of these expanses, the strike consequently owning its name to it. They are built-up of clearly marked linear folds and shells. Folds are commonly slanted or overturned, with a characteristic south-west vergence (Fig. 1, A).

The old Pyreenean structures of Dinaric strike, having been hit by the new neotectonic stress in a south-north direction. »tend« to preserve their existing form. Under the force of kinematic laws, the most favourable way to sustain the internal fabric geometry is to set the form in a position which can most successfully resist the new deformation process, consequently, by setting the structure normally to the new stress. Due to this fact, structures use the shortes possible route to rotate towards the strike direction of east-west, rotating therefore to the left (retrogradely) around the subvertical axis of mean stress – σ_2 (Fig. 1, B).

The space required for rotation is created by a lateral stress relief along large transcurrent faults due to right-hand horizontal movement. Right transcurrent faults being by their kinematic type within the HO1 shearing zone, are at the same time often accompanied by synchronous HO1 faults due to the left-hand horizontal movement. Mutually, they create conjugated pairs, closing the so called »dihedral angle« (Fig. 1, B).

This kinematic act is also directly accompanied by opening of large, gaping, not filled-in tension fissures, parallel with the global stress direction.

During the whole period of action, this global stress keeps a permanent orientation (south-north), presenting the sole cause of contraction. Due to this fact, any point within the structure has the same highest stress orientation (σ_1). In dependance on the local kinematic condition, only the mean (σ_2) and the lowest (σ_3) stresses will interchange their values.

These changes within the area of deforamtion due to retrograde rotation have a directed increase, controlled by the progression of structure's deforamtion, according to the position of normal strike (east-west) on the global stress. As the destruction of Pyreenean primary design commences with a retrograde rotation around the sub-vertical mean stress – σ_2 (Fig. 2, A), in the course of kinematic development the axis of mean stress (σ_2) more and more inclines and »dips« towards the horizontal position (Fig. 2), keeping however the same sense of rotation. The initial retrograde rotation thus expresses itself in the terminal kinematic stage as a rotation due south (Fig. 2, D). Structures assume the »Hvaric-Strike« (named after the island of Hvar in the Adriatic) positions, so that a full expression of tangential neotectonic movements, i.e. reversible thrusting and overthrusting, begins.

It has to be pointed out that all these kinematic states (Fig. 2) present a mere aggregate outlay of different movement types of geometric points within a structure under the specific stress. Their kinematic level is for each of specimens absolutely internal, so that their direct interlinking is illusory. All these stadia are based upon real data about spatial position and present a real reflection of the structural deformation's state. All these »stages« happen however simultaneously, but in different spots of a particular primary structure; within the scale of local structurl-kinematic position.

In a common instance of neotectonic deformations, the west block of right transcurrent fault presents a »lateral root« of the overthrusting structure. The fault strikes approximately north-south, has a vertical plane and right-hand horizontal movement vectors. This is the space wherein the retrograde rotation proceeds (Fig. 2, A).

More to the south, within the north-west/south-east zone, due to the right-hand reverse movement, the fault is inclined due north-east (Fig. 2, B, C), while in the zone wherein the fault keeps the approximately Hvaric Strike movement vectors have a perpendicular sense of true reverse movement along the plane of medium inclination (Fig. 2, D).

Thus, in fact, all changes of the deforamtion ellipsoid's state do nothing but sketch out the structural form geomety under the same global stress. consequently, they present no more than a local kinematic demonstration in its narrowest meaning. After all, the retrograde rotation itself is in fact a secondary occurence, caused by the neotectonic stress in course of a specific regional structure's deformation.

* * *

Decametric folds, with an unexpected northerly vergence, can often be found within the »Koviljača« structural unit, upon northern slopes of the Neretva river canyon. At the same time, large hectometric folds, comprised within the same structural unit, have the southerly vergence and a low compression index, while folds with the northerly vergence are strongly compressed. What is characteristic here is that folds with the northerly vergence also demonstrate a mild scattering of, axis, whereas when they find themselves within a set of adjacent parallel folds, often both vergences appear (northern and southern), possesing different inclination values (Fig. 3).

These global characteristics can hardly be tied up with the global tangential stress action. In all probability, they came into being as secondary products of the gravitational stress prevailing over the tangentional one. That is, they could have been created in relaxation phases, due to gravitational sliding of folds having the primary southerly vergence and a constant axis orientation (east-west), via an action of the mechanism reminiscent of the so called »Hansen-plot« (1971, 27–51).

The mechanical basis for such deforamtion style is exposed by the structural and morphological position of the »Koviljača« unit. Namely, the fundamental physiography of this unit, upwards the Pometenik Hill, is framed by its righ-hand transcurrent fault at 220 m a.s.l. Approximately 4 km due south, this continuous tectonic surface occurs as a right-hand reverse fault at 80 a.s.l. In both cases occur the identical structural-stratigraphical relationships along the regional fault, allowing thus an assesment that the whole »Koviljača« unit's structural plan is inclined for 3.5° due south. Sliding could have occured at a larger depth, due to hydrostatic pressure of the increased plasticity state of deposits.

Debate

It is quite natural to suppose that such neotectonic kinematics of deformation does not pose a mere exceptional case along the river Neretva's middle course.

The appearance of »Hvaric Strike«, together with its close structural connection with right-hand transcurrent faults, as well as the tectonic relationship with younger deposits (oligocene, Miocene), is a quite common occurence in the outer Dinarids. This investigated area is a small segment of the Prenj nappe s western part, but, in all probability, (Mojičević & Laušević, 1973), it presents an essential feature of the Prenj – Čvrsnic complex.

The Plavno – Svilaja nappe (Grimani et. al., 1975; Ivanović et. al., 1978; Papeš et. al., 1984) also points to the similar structural – tectonic nature of the fabric. Indeed, abandoned Oligocene brown coal mines are to be found under the lower surface of Svilaja nappe, near the Neorič village.

All geological maps show the Svilaja nappe illustrating, in essential outlines, the identical deforamtion kinematics. (Fig. 1, C) The intervention had been performed by Šikić (1964) and Komatina (1968). In their construction, they stretch a deep transcurrent fault thoughout the structure, »cutting through the whole stone crust«, including as well the Split flysh synclinorium. The first author denotes it as the »Knin fault«, and the other as the fault of »Butišnica«. It is interesting that, at a later time, due to the lack of material evidence. Šikić (1976) cuts this fault short, stretching it no farther than the Svilaja nappe. *M. Vidović* (1970) as well expresses an opinion that these horizontal faults are of »exceptional character«.

It must be said that the right-hand transcurrent, resp. right-hand reverse faults have not cut through the existing nappes. They make an integral, constituent part of the nappe, being therefore as deep as the nappe itself and do not exist outside the latter's total form (Fig. 4).

A special attention and explanation is imposed by a certain, not particularly uncommon, occurence of younger strata reversibly thrusted upon older ones. Arguments regarding their interpretation are due to the habit of reproducing the historical inception of tectonic relationships recognition, based solely upon the stratigraphic analysis of realtionships among deposits. If the interrupted sequence of deposits happens to be inverse, one speaks about a reverse fault, while the absence of inversion of strata is ordinarily interpreted as gravitationally dipped block of younger strata. The direct observation of real movement vectors, using the example of Pometenik, Hill (704 m), implicates that Albic – Malmic limestones of Pometenik have been overthrusted over Malmic dolomites by a right-hand reverse movement. The right-hand reverse movement had been taking place upon a more than 300 m deep plane (this representing only its exposed part on the western slope of the Neretva canyon), inclined at 50° due north/noth-east.

As the retrograde rotation of preliminary design occurs around the subvertical mean stress, by means of a right-hand transcurrent movement, it is natural that, after a certain period of time, totally different stratigraphic members find themselves in an immediate stratigraphic contact. In a new kinematic act, the to right horizontally moved blocks begin a right-hand reverse movement. They thrust upon the on-the-spot deposits of the south-western slope, without choosing either the strtigraphic sequence or stratigraphic inversion.

1. Veliki tektoglifi na plohi desnog transkurentnog rasjeda između donej krede i oligocena. (Cesta Mostar - Jablanica).

1. Large tectoglyphs on the right-hand transcurrent fault plane between Lower Cretaceous and Oligocene. (On the Mostar - Jablanica road.)

2. Desni transkurentni rasjed s tendencijom prijelaza u desni reverzni rasjed. (Cesta Mostar - Jablanica).

2. The right-hand transcurrent fault having tendency of transition into a right-hand reverse fault. (On the Mostar - Jablanica road.)

3. Ploha desnog reverznog rasjeda između donje krede i oligocena. (Cesta Mostar – Jablanica).

3. The right-hand reverse fault plane between Lower Cretaceous and Oligocene. (On the Mostar – Jablanica road.)

4. Reverzno natisnuti albsko-cenomanski vapnenci na malmske dolomite. (Brdo Pometenik)

4. Thrusted Albic-Cenomanian limestones upon Malmic dolomites. (Pometenik hill.)