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SOME COMMENTS ON STRATIGRAPHIC CLASSIFICATION AND TERMINOLOGY

The necessity to respect priority in defining notions and terminology is pointed out. As a result of the comparison of various classificational systems, the chronostratigraphic one is considered most suitable for world wide usage; the lithostratigraphic system may be applied in the reconstruction of regional relations; the biostratigraphic one is considered basic for presentation of the evolutionary tempo of organisms through geological time and supplementary for chronostratigraply. The elementary categories of the systems, i. e. stage, formation, and zone, are discussed.

1. INTRODUCTION

A revision of any method of classification and introduction of new terms may be either the consequence of a considerably enriched knowledge in a scientific field or a sign of the impossibility of mastering the accumulated problems. Unfortunately, the second case is more frequent than the first one. Therefore, an endeavour to standardize systems and notions applicable, in all geological centres and in all languages, may be a permanent duty of all those interested in the problems in question, This is a proposal of how to avoid a superfluous overlapping of different systems.

2. PRIORITY OF TERMS AND DEFINITIONS

First of all, the necessity to respect the priority of defined notions and terms used, analogous to the biological nomenclature, should be emphasized. A few examples may illustrate how a small advantage can cause a great disadvantage.

The introduction of the series »Middle Carboniferous« and »Middle Permian«, after a long-lasting practice of dividing both systems into

only two series (Lower und Upper), has contributed to a better understanding of the sequences within the systems. But at the same time, the designations »Lower« and »Upper« have become homonyms, and their usage (in the old or new sense) should be more thoroughly explained.

The lack of an international agreement concerning the inclusion of the Rhaetian into the Triassic (as the last stage) or into the Lias (as the first stage) has confused some palaeontologists as to the definition of the beginning of the Mammals; some mention the Triassic, the others the Jurassic as the starting period, although the same stage is in question.

The lack of a unanimous treatment of the Palaeocene, either as an equivalent category to the Eocene or as a part of it, may bring about vague formulations (like »at the beginning of the Eocene«); therefore, additional explanations are necessary. However, terms requiring additional explanation are not very useful for classification.

The Sarmatian was first defined by Suess. Since then it has been broadened to include also the Chersonian. This has made a better reconstruction of the lithostratigraphic sequence possible at the type locality. But now the term Sarmatian is used as a homonym; its scope should be further ascertained.

The term »formation« had been used for decades to indicate an elementary lithostratigraphic unit; then the same term was introduced for tectogenetic units, with the essential difference, that the formation as a litostratigraphic unit cannot repeatedly occur in a geological colomn, while the tectogenetic formation can (e. g. flysch, molasse etc.). In this case, however, the different meaning is easy to notice, because the lithostratigraphic formation should be formally named, the tectogenetic one not. Nevertheless, homonyms do not help classificational procedure.

Any change, analogus to the mentioned ones, should not be accepted as valid unless it is confirmed by an international board.

3. PROVENANCE OF NAMES

New terms should be constructed only on the basis of Latin or Greek words. Only thus, could they be used vith the same meaning in all world languages. Otherwise, when terms must be translated, a devitation from the original meaning is inevitable. The fact that sometimes the meaning of the words (e. g. acrozone or epibole) doses not correspod to their definitions, should not be the reason for changes, because the scientific terms would assume their significance from their definitions (despite their origin). If the opposite trend prevailed, then, also, the terms Ordovician, Carboniferous, Triassic, Cretaceous, Tertiary, etc., should be changed. Nevertheless, they are used without confusion.

4. INCONSISTENT USE OF CLASSIFICATIONAL SYSTEMS

The inconsistent use of classificational systems also creates difficulties. As it is well-known, three classification systems are used in stratigraphy, i, e., chronostratioraphic, lithostratigraphic and biostratigraphic. Not infrequently, the first two are treated as if they belonged to the same rank, the third as supplementary to chronostratigraphy.

The chronostratigraphic system is highly consistent, because it is based on definite (but not equal) time units comprising of equivalent rock and fossil content, as documents of corresponding dynamics. The two other systems are partial, because they are based on specific data, either lithological or palaeontological, and the duration is not an element of the definition which should be unchangeable within the units.

It does not seem superflous to recall, that the first stratigraphic units were created after a clear vertical distinction of lithological units, which, as a rule, were characterized by some specific fossils (index fossils). That was the beginning of the creation of s t a g e s or s y s t e m s, basic units of chronostratigraphy. Elementary units became stages, defined at type localities. They are used as a common basis for the correlation of beds of the entire Globe, with duration corresponding to the defined stratotypes of stages as rock-time units. Lithological equivalence is not postulated. Even the discontinuity of correlated new complexes is possible. Consequently, a new registered continuous lithological sequence may be the equivalent of several stages, while in another case, two or more discontinous complexes my correspond completely or partly only to one stage. Hence, the unlimited global application of this system, as a whole, conceptual consistency, and the possibility of respecting priority in every case. The stages, once defined, might be changed only in cases, when, at a stratotype, sequences primarily held consistent (continuous) are discovered discontinuous. The reliance and clearness of one single meaning of each term, resulting from such a procedure justifies the effort for correlation within global relations.

To avoid the difficulties of consistent chronostratigraphic correlation, two different methods have been followed. One of them has led to stage changes, to looking for more »typical« stratotypes etc., causing a multiplication of names, intermixing of various units (creating of synonims), etc. The other way has led to a continuation of the primary procedure of distinguishing consistent lithostratigraphic units. It has ended in the creation of a consistent lithostratigraphic classification system, based on the practical need for delimiting homogene lithologic entities, regardless of their chronostratigraphic scopes, which, in many cases, have been hard to establish. In this way, f o r m a t i o n has been created as the formal basic unit of the system, as well as numerous informal units called »beds«, »deposits«, and even informal »formations«. The use of such units as supplementary to the chronostratigraphic

system is justified, because it contributes to a better definition of chronostratigraphic units by showing the scope of continuity or discontinuity within the chronostratigraphic units of a particular region. But, the frequent propositions of substituting such units for validly defined stages are superfluous and violate the principle of priority.

In many countries, the creation of formations has exceeded all reasonable rates, making international correlation very complicated and hard to manage. The use of informal categories in Europe, and the attempt to propose them as new stratotypes, despite the existence of the already defined stages for the corresponding time spans, has brought about a multiplication which has, rather than helping, shattered all consistent classification. Especially in the Carboniferous, Permian and Neogene the names are continually substituted for each other in order to find more »typical« ones, though the systems in question are characterized by a very intensive horizontal and vertical variabilitiy of marine, transitional, and terrestrial enviroments. If stages are in qrestion, the introduction of new names (sometimes with changed scopes) does not at all contribute to a better classification. If it is difficult to correlate new complexes to their primary stratotypes, the same difficulty will crop up in attempts in the opposite direction. For example, if it is impossible to correlate Trogkofel-beds to the Artinskian (and partly Kungurian) stage, the same is valid in the opposite sense, if Trogkofel-beds are defined as a new stratotype. Moreover, in spite of the ever continuing dispute about the scope of Pannonian beds (displaying different scopes at various localities), the Pannonian is often used in the meaning of a stage, etc.

5. COMBINED USE OF CHRONO- AND LITHOSTRATIGRAPHIC UNITS

Instead of the mentioned practice, a combined use of chronostratigraphic and lithostratigraphic units (formal and informal) may be proposed, retaining primary stratotypes, and treating lithostratigraphic units as supplementary only. The number of formal and informal lithostratigraphic units may be unlimited, under the condition that they are correlated to primary stages. Since a formation (in three dimensions), mostly, does not have the same vertical scope in every profile, it cannot replace any defined stage, because the essential feature of stages is their unchangeable scope.

6. THE DOUBLE ROLE OF FOSSILS

Though fossils play an important role in the determination of relative age and scope in chronostratigraphic units, the biostratigraphic classification system has tendency to present the tempo of organism evo-

lution through geological time, by means of well-defined chronostratigraphic units. Consequently the use of zones has been improved. First they were applied as units with a smaller scope than the stage to which they belonged, as supplementary units of chronostratigraphic classification. Meanwhile zones exceeding one or more stages have been established. This has been the beginning of the biostratigraphic classification system, in which zones have their specific biostratigraphic role, i. e., the determination of time scope of taxons and assemblages with the registration of the beginning, blossom, and extinction of each of them. For this purpose, already well defined chronostratigrapihc units are needed. Naturally, in the same procedure the fossils in question may assist a better definition of chronostratigraphic units, but this does not eliminate their specific role. Nonetheless, an emendation of the scope of chronostratigraphic units might not be performed on the basis of new zones, unless they require changes within the stratotype sequence. This is to be recommended not only due to priority, but also because the scope of a zone can be enlarged practically with every new finding of fossils, while the permanency of the scope of stages is a fundamental characteristic. A specific biostratigraphic role may be attributed to all types of zones. Consequently, the term chronozone is hardly justifiable, even when its scope is less than a stage.

7. STRATOTYPES AND TYPE AREAS

According to the previous considerations, only stages aught to be based on stratotypes. As to the formations, formally named, it is possible and necessary to define their type areas, while the scope of zones has practically to be considered open, because every new discovery can broaden it, as long as the fossils of the organisms in question are not finally explored.

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M. HERAK

NEKE PRIMJEDBE UZ STRATIGRAFSKU KLASIFIKACIJU I TERMINOLOGIJU

1. UVOD

Svaka promjena klasifikacije i uvođenja novih termina može biti odraz znatnijeg napretka određene znanosti, ili pak nemoći u prevladavanju nagomilanih problema. Nažalost drugi je slučaj češći od prvoga. Zbog toga, pokušaji standardizacije sistema i pojmova, primjenljivih u svim geoloških centrima i u svim jezicima, trajna su obveza svih koji se zanimaju za tu problematiku. Ovdje se raspravlja o načinu kako da se izbjegne preklapanje različitih sistema.

2. PRIORITET TERMINA I DEFINICIJA

Kao prvo treba naglasiti potrebu poštivanja prioriteta pojma (definicija) i naziva — analogno biološkim nomenklaturnim principima. Spomenuo bih samo nekoliko primjera koji pokazuju kako mala korist može izazvati veću štetu.

Uvođenje novih serija »srednji karbon« i »srednji perm«, nakon što su dulje vremena oba sistema bila dijeljena u dvije serije (donju i gornju), pridonijelo je boljem razumijevanju sekvenci unutar sistemâ. Ali time su oznake »donji« i »gornji« postale homonimske, pa njihovu upotrebu (u starom ili novom značenju) treba posebno obrazlagati.

Nedostatak međunarodne suglasnosti u pogledu uvrštavanja reta u trijas (kao završni kat) ili u lijas (kao početni kat) unio je pometnju u određivanju početka sisavaca. Neki autori spominju trijas ,a drugi juru, kao početne periode, iako je isti kat u pitanju.

Pitanje paleocena kao samostalne jedinice ili kao dijela eocena unosi nejasnoće u formulacijama, kao što je npr. »početkom eocena« i sl., pa je potrebno dodatno objašnjenje da li je u nekom slučaju u eocen uključen paleocen ili ne. A termin koji treba naknadno objašnjavati nije osobito pogodan za klasifikaciju.

Nakon Suessova definiranja sarmata, izvršena je revizija. Pojam je proširen uključivanjem hersona. Tako je, s obzirom na locus typicus, potpunije zahvaćen litostratigrafski kompleks, ali nakon toga pojam treba pobliže objašnjavati.

Nakon što je termin i pojam formacije kao litotstratigrafske jedinice doživio i doživljavao bogatu primjenu kroz decenije, neki geolozi uvode pojam formacije za tektogenetsku cjelinu. Bitna je razlika u tome što se formacija u litostratigrafskom smislu ne može ponavljati, a u tektogenetskom može (npr. formacija fliša, formacija molase i sl.). No, u ovom slučaju, usprkos uvođenja homonima, nesporazumi su manji zbog toga, jer je obilježavanje formacije kao litostratigrafskog pojma formalno definirano, što u drugom slučaju nije. Pa ipak, homonimi ne olakšavaju klasifikaciju.

Svaka promjena, analogna opisanima, smjela bi se izvršiti samo na osnovi zaključka meritornog međnarodnog tijela.

3. PORIJEKLO IMENA

Nove termine trebalo bi kreiriati isključivo na bazi latinskog odnosno grčkog korijena, ako želimo da budu jednoznačno primjenjivani u svim jezicima svijeta. U protivnom slučaju dolazi do prevođenja, a time i do neminovnih devijacija.

Činjenica da same riječi (npr. »akrozona«, odnosno »epibola«) ne pogađaju do kraja pravi smisao definicije, ne bi trebala biti mjerodavna, jer za znanstveno značenje nekoga termina nije mjerodavan korijen riječi, već definicija pojma koji se određenim terminom označava. U protivnom bi trebalo mijenjati i nazive ordovicij, karbon, trijas, kreda, tercijar i dr., pa ipak oni su u upotrebi bez poteškoća.

4. NEDOSLJEDNOST U PRIMJENI KLASIFIKACIJE

Nedosljednosti u primjeni klasifikacijskih sustava također izazivaju nepotrebne nesporazume.

Kao što je dobro poznato, u stratigrafiji su razrađena tri sustava klasifikacije: kronostratigrafski, litostratigrafski i biostratigrafski. Pritom se često kronostratigrafska i litostratigrafska klasifikacija upotrebljavaju kao sustavi istoga ranga, dok se biostratigrafija najčešće tretira kao pomoć kronostragrafiji.

Kronostratigrafski je sustav krajnje konsekventan, jer se svodi na određene (ali ne i jednake) jedinice vremena i jer obuhvaća cjelokupno zbivanje u okviru tih jedinica. Ostala dva sustava su parcijalna, jer se svaki od njih oslanja samo na specifične promjene, litološke ili paleontološke, a trajanje nije element definicije koji bi morao biti stalan unutar jedinica.

Ovdje možda neće biti izlišno da se još jednom podsjetimo da su prve stratigrafske jedinice formirane na jasnom vertikalnom razlikovanju određenih litoloških cjelina, koje su redovito bile karakterizirane i specifičnim fosilima (provodnim fosilima). Takve su jedinice kasnije nazvane kat ili sistem, ovisno o tome da li zauzimaju veći ili manji vertikalni (a time i vremenski) raspon. Tako su nastale prve kategorije kronostratigrafske klasifikacije. Osnovnom kategorijom proglašen je kat, definiran na tipičnom lokalitetu. Katovi služe kao prototipska osnova za korelaciju dijelova naslaga Zemljine kore (bez obzira u kojem se području nalazili), koji im po vremenu postanka odgovaraju. Litološka podudarnost nije neophodna, a moguć je i diskontinuitet u naslagama koje se koreliraju. Tako se može dogoditi da jedna homogena litološka cjelina predstavlja ekvivalent više katova, ili da unutar jednoga kata bude više litoloških cjelina, a ponegdje i hijatusa. To jasno pokazuje mogućnost globalne primjene kata kao jedinice klasifikacije, njegovu stabilnosti i primjenljivost principa prioriteta. Prvotno opisani kat (a s tim povezano i ime) smio bi se mijenjati (uz pristanak međunarodnog foruma) samo u slučaju kada se dokaže da unutar litološkog kompleksa tipičnog lokaliteta, koji je shvaćen kao homogen (te je kao takav poslužio kao osnova definiranja kata), postoji jedan ili više hijatusa. Sigurnost, jasnoća i jednoznačnost takvog postupka nadoknada su za sve one poteškoće koje se javljaju pri korelaciji globalnih razmjera.

Da bi se izbjegle poteškoće u konsistentnim kronostratigrafskim korelacijama, krenulo se u dva smjera. Jedan je išao za tim da se mijenjaju katovi, da se nađu »tipičniji« lokaliteti i sl. Tako dolazi do množenja imena i do poistovjećivanja različitih jedinica (stvaranja sinonima), itd. Drugi je smjer doveo do formiranja konzistentnog litostratigrafskog sustava, a opravdanje mu leži u praktičnim razlozima. Pri regionalnim istraživanjima, osobito kartiranju, pokazalo se oportunim da se izdvajaju homogene litološke cjeline bez obzira

na kronostratigrafski raspon, koji, usput budi rečeno ,nije uvijek bilo lako ustanoviti. Tako je nastala i formalno definirana formacija kao osnovna kronostratigrafski raspon, koji, usput budi rečeno, nije uvijek bilo lako redu različiti »slojevi«, »naslage«, neformalno shvaćene »formacije«, i dr. Upotreba takvih jedinica kao dopune kronostratigrafiji opravdana je u punoj mjeri, jer dodaje novu kvalitetu, pokazujući raspone kontinuiteta odnosno diskontinuiteta kronostratigrafskih kategorija u nekoj regiji. No, veoma česta praksa da se te jedinice predlažu umjesto definiranih katova neopravdana je, jer se uz ostalo ogrješuje i o princip prioriteta.

Dok pretjerana upotreba formalno jasnih litostratigrafskih kategorija (u prvom redu formacija), pretežno u izvanevropskim zemljama, ima za posljedicu samo izvanredno otežanu korelaciju na veće udaljenosti (što je preraslo u jedva rješiv problem), upotreba neformalnih kategorija, pretežno u Evropi, i sve češći pokušaji da se te kategorije pretvore u nove katove, usprkos postojanja definiranih katova za određeno vremensko razdoblje, dovodi do potpuno nepotrebne multiplikacije koja, umjesto da pomaže, rastače svaku sređenu klasifikaciju. Kao nepoželjne primjere spomenuo bih neprestane novitete u klasifikaciji karbona, perma i neogena, gdje jedno ime smjenjuje drugo u težnji da se nađu »tipičnije« jedinice u sistemima za koje je upravo varijabilnost dominantno svojstvo, jer se izrazito isprepliću morski, prelazni i kopneni utjecaji. Pritom se zaboravlja da se uvođenjem novih naziva za katove, ponekad s izmijenjenim rasponom, ništa ne popravlja. Jer, ako je teško korelirati neke naslage s prvotno definiranim katom, isto će tako biti teško korelirati naslage prvotnog kata s novim katom. Npr. ako je teško odrediti korelaciju trogkofelskih naslaga s artinskim katom (eventualno dijelom kungura), onda će jednako tako biti teško odgovarajuće ruske naslage korelirati s trogkofelskim katom, ako ga prihvatimo. Ili, zar ne raspravljamo još uvijek o rasponu »panona«, koji sigurno nije svagdje isti, dok ga istovremeno uvrštavamo u svojstvu novo definiranog kata, itd.

5. KOMBINIRANA PRIMJENA KLASIFIKACIJSKIH SUSTAVA

Umjesto postojeće predlaže se kombinirana primjena kronostratigrafskih i litostratigrafskih jedinica (formalnih i neformalnih), s tim da su stratotipovi katova primarni, a litostratigrafske jedinice dopunski elementi. Broj formalnih i neformalnih litostratigrafskih jedinica mogao bi biti neograničen, ukoliko se koreliraju s primarnim katovima. S obzirom na to ,da formacija, gledana trodimenzionalno, ne mora imati (a najčešće i nema) u svim profilima isti vertikalni raspon, ona ne može poslužiti kao supstituent za neki kat kojemu je fiksirani raspon bitna karakteristika.

6. DVOSTRUKA ULOGA FOSILA

Iako fosili imaju bitnu ulogu u determiniranju relativne starosti i raspona kronostratigrafskih jedinica, biostratigrafski sustav ima svoj vlastiti cilj, a taj je da se na osnovi definiranih kronostratigrafskih jedinica dade prikaz tempa razvoja organizirana u geološkoj prošlosti. U vezi s tim je i primjena pojma zona. Zone su najprije stekle svoju stvarnu upotrebnu vrijednost kao jedinice manjeg vertikalnog raspona od kata. Međutim, mnoge zone prelaze okvir kata, pa tako preuzimaju svoju specifičnu biostratigrafsku ulogu utvrđivanja raspona taksona i zajednica uz određivanje početka, cvata i kraja svakoga od njih. To se može postići samo na temelju dobro definiranih kronostratigrafskih jedinica, što ne znači da nije moguće i povratno djelovanje, tj. da biostratigrafske jedinice pridonesu jasnijem definiranju katova, serija,

sistema, pa i eratema. Međutim, nije opravdana praksa da se na osnovi sve bolje definiranih zona mijenjaju rasponi kronostratigrafskih jedinica, ne samo zbog poštivanja prioriteta, nego i zbog toga što vertikalni raspon zone može biti povećan na osnovi novih nalaza, dok upravo stalnost raspona mora biti osnovna karakteristika kronostratigrafskih jedinica. S obzirom na to teško se može opravdati izraz kronozona, čak i u slučaju kad se odnosi na jedinicu manju od kata.

7. STRATOTIPOVI I TIPSKI AREALI

Na osnovu rečenoga jasno proizlazi da od tri elementarne jedinice navedenih sustava jedino kat može i mora biti vezan uz stratotip. Za formaciju se može odrediti tipski areal, dok zona mora ostati otvorena jedinica s mogućnošću promjene raspona u vezi s novim nalazima.

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