International Tectonic Lexicon

A Prodrome

Editor-in-Chief: J. G. Dennis, Long Beach, California

Part I: Fundamental Tectonic Terms
by J. G. Dennis, Long Beach and H. Murawski, Frankfurt a. M.

Part II: Terminology of Cleavage and Schistosity
by J. G. Dennis, Long Beach and K. Weber, Göttingen

International Union of Geological Sciences

International Geological Correlation Program
Project No. 100 – F. M. DELANY, Paris, Project Leader

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With 13 Figures and an Appendix in the text

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Preface

The International Tectonic Lexicon brings together a first selection of important tectonic terms, explains their meaning and suggests equivalents in the six languages of the International Geological Congress: English, French, German, Italian, Russian, and Spanish. It is in two parts: Part I, Fundamental Tectonic Terms, includes terms which are considered to be important in geological documentation; Part II, Terminology of Cleavage and Schistosity, is designed to be a prototype for similar compilations in other specialized areas. The Lexicon has been called a prodrome because it is a preliminary publication, completed with limited funds. It includes what we and our correspondents consider to be first priority terms. We may have omitted important terms, and at the same time may have included terms which, in the opinion of some, might not merit inclusion. That is the risk taken by all who edit compilations. We hope that this small volume will be a source of information and education for many colleagues in all countries, and that, as a result, a larger volume may one day appear.

One of the satisfactions of our work has been the continuing international collaboration, both by correspondence at the rare editorial conferences. It is hoped that the result will help others increase their international contacts. We welcome translation of the Lexicon into other languages, under the usual conditions.

We should like to express our appreciation to all who have helped in the completion of this work. Their names appear in the introductions to the two parts. In addition, we wish to thank our research assistants Lynn Gray (Long Beach) and Lorant Gangel (Frankfurt) for truly high caliber work. We are also indebted to Lorant Gangel and Jeffrey Boyd for the drafting. – A specialized multi-language compilation such as this presents many unusual technical and publishing problems. We are greatly indebted to Dr. E. Nägele and the Schweizerbart publishing house for their patience and understanding. They have had an important share in the successful completion of our enterprise.

This work has been made possible in part by funding through the Richard Merton Fund of the Deutsche Forschungsgemeinschaft, and through grants by the International Geological Correlation Program.

J. G. D. H. M. K. W.

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Part I

FUNDAMENTAL TECTONIC TERMS

By J.G. Dennis and H. Murawski

Introduction

Geological terms and, more particularly, tectonic terms have long suffered from disagreements as to their definition. Ideally, scientific terms are precisely defined, and carry a fixed, universally agreed connotation. If this were so in geology, it would be safe to say that a great many controversies need never have arisen. In reality, tectonic terminology suffers from semantic inconsistencies which hamper communication between geologists and other scientists, between geologists speaking different languages, and, most certainly, between geologists speaking, supposedly, the same language.

The International Tectonic Lexicon was conceived to alleviate this situation. It became a project of the Subcommission for the Tectonic Map of the World at the 21st International Geological Congress in 1960 (see Dennis, 1967, p.x.). Responsibility for the project was assigned to the parent Commission for the Geological Map of the World (CGMW) at the 22nd International Geological Congress in 1964. Since then a number of single-language terminologies have appeared, both in published and in typescript format under the general sponsorship of the Commission. At the 24th International Geological Congress in 1972, F. Delany, Secretary-General of CGMW, submitted a prototype international lexicon of 16 tectonic terms in French (Delany, 1972), compiled from existing single language terminologies, and designed as a model for a planned larger multi-language compilation. The opportunity to implement this larger project arose with the establishment of the International Geological Correlation Program (IGCP). In 1974, J.G. Dennis and H. Murawski submitted an implementation proposal to IGCP through CGMW. As a result, IGCP Project No. 100 the International Tectonic Lexicon, was established with J.G. Dennis and H. Murawski as editors and F. Delany as project leader.

The editors next circulated a provisional manuscript to Project members F. Dunning (United Kingdom), A. Caire (France), K.-B. Jubitz (G.D.R.), R. Rey (Spain), M. Manzoni (Italy), H. Masson (Switzerland), and V.E. Khain and V.P. Kolchanov (U.S.S.R.). Copies were also sent to an Advisory Panel which included J. Débelmas and C.T. Le Pichon (France), P.B. King and J. Rodgers (U.S.A.), and R. Trümpy (Switzerland). Comments and suggestions from these colleagues were incorporated in the original manuscript. Next, an editorial committee, consisting of J. Dennis (Chairman), H. Murawski, H. Masson, and R. Sacchi thoroughly evaluated and amended the then existing material for the Lexicon.

This lexicon has been written for the six official languages of the International Geological Congress. Since it is not possible to establish absolute equivalence in connotation between terms in any two languages, it was decided to base the work on English as reference language, and to note any deviation in meaning in other languages under Paragraph 3, Current Usage. We welcome translation into other languages, under the usual conditions.

Some notes concerning the paragraph headings under each term:

1. Derivation: This is the derivation of the English term. The abbreviation O.E.D. means "Oxford English Dictionary".
2. Definition: This constitutes the authorized definition of the International Geological Congress, for use on geological and tectonic maps and other international geological documentation. In some cases it has been kept deliberately broad, in order to accommodate minor variations in usage. More precision can then be attained by the use of qualifiers.
3. Current Usage: This paragraph indicates whether, and to what extent, current usage in each language follows the definition under 2, or deviates from it.
4. History: This paragraph refers the reader to key literature on first definition and subsequent changes in meaning. For English, our principal source has been the International Tectonic Dictionary, English Terminology (Dennis, 1967), and Dennis and Atwater (1974) with many modifications. For German, our standard source has been Deutsches Handwörterbuch der Tektonik (Murawski, 1968–1979), also abbreviated DHT in the text. For French, we made use of F. Delany's Essai (Delany 1972) and a typescript by A. Caire. For Russian, we used a multilith by Kolchanov and Leonov (1971). In all cases, we received further input from the contributors named above, and from the references listed.
5. Special Notes: This heading provides space, as needed, to draw attention to special features in the use of the term in some of the languages.
6. Tables and diagrams appear in this space, as needed.

Four entries do not follow the above scheme: *Fault Classification*, which lists the different types of faults; *Fault Displacement*, which lists slip and separation terms; *Measurement of Attitude*, which lists dip and strike and related terms; and *Symmetry Axes* (in Part II), which lists fabric, fold, and kinematic symmetry axes, and principal axes of strain.

The Editors wish to thank their research assistents Lynn Gray (Long Beach) and Lorant Gangel (Frankfurt) for truly high caliber work. They are also indebted to Lorant Gangel and Jeffrey Boyd for the drafting. This work has been made possible in part by funding through the Richard Merton Fund of the Deutsche Forschungsgemeinschaft, and through grants by the International Geological Correlation Program.

JGD HM

List of terms

* Main heading for several related terms.

Allochthone, Allochthonous

English: Allochthone, Allochthonous
French: Allochtone
German: Allochthon
Italian: Alloctono
Russian: Аллохтон
Spanish: Alóctono

1. Derivation: Greek *allos,* other; *khthon,* earth, ground.

2. Definition: An allochthonous rock mass or allochthone is a rock body that has been transported from its original site of emplacement.

3. Current usage:
English: Follows definition.
French: Follows definition; in the Swiss Alps, an *"allochtone"* is assumed to have traveled at least 10 km approximately. For rock bodies that have traveled smaller distances, the term *"parautochtone"* is used.
German: Follows definition; the noun *"Allochthon"* is rarely used in German. See also French usage above and Murawski (1976) under *"Allochthon"*.
Italian: Follows definition.
Russian: Follows definition.
Spanish: Follows definition.

4. History: (a) First used as an adjective to designate rocks of distant origin: *allochthone limnatische Gesteine* (Naumann, 1858, p. 657). Gümbel (1884) applies the term to coal formed by transported plant material (hence, allochthonous coal).
(b) At the beginning of the 20th century, the term acquired a tectonic connotation to designate rock units of varying dimensions (such as nappes and nappe complexes) which, as a result of tectonic transport, have come to rest on a distant substratum (e.g. Wilckens, 1912, p. 40–41).
The term still is being used in sense (a) for transported coal and other transported residual rocks, and in sense (b) for transported tectonic units (e.g., Kay, 1945b,

p. 440). It is, however, commonly difficult to determine whether transport has been tectonic or sedimentary, particularly in the case of minor blocks, also known as exotic blocks (e.g., in the Wildflysch). "Allochthonous" may refer to various redeposited sedimentary materials from more or less distant sources (usage of some Italian authors).

Anteclise

English: Anteclise
French: Antéclise
German: Anteklise
Italian: Anteclisi
Russian: Антеклиза
Spanish: Anteclisa

1. Derivation: Greek *anti,* against; *klino,* incline.

2. Definition: An updomed platform structure of large areal extent (tens or hundreds of thousands of square kilometers). The map outline is irregular, elongated or equidimensional. Older rocks and occasionally even basement crop out in the central region. Cover rocks dip quaquaversally outward at angles of fractions of a degree.

3. Current usage:
English: Follows definition, but rarely used (see 5). Equivalent terms in English: arch, and dome (as epeirogenic structures).
French: Follows definition; rarely used (introduced by Bogdanov et al., 1963).
German: Follows definition; but rarely used (introduced by Shatsky & Bogdanov, 1958). See also Murawski (1976) under *"Anteklise".*
Italian: Follows definition.
Russian: Follows definition.
Spanish: Follows definition; but very rarely used. Equivalent terms in Spanish: *domo, abombamiento.*

4. History: The term "anteclise" was first used by V.A. Teriayev (1916), and later by A.N. Mazarovich who used it for a gently dipping anticlinal platform structure. The present meaning of the term was proposed by N.S. Shatsky (1945).

5. Special notes: Cover rocks are predominately shallow water or continental sediments, with characteristically incomplete sections and reduced thicknesses.
Examples: the Volga – Urals, Belorussian anteclises; also, Cincinnati arch, Ozark dome.

6. Illustration: North rim of Voronesh Anteclise, after A. A. Bogdanov, M.V. Mouratov & N.S. Shatsky (1964).

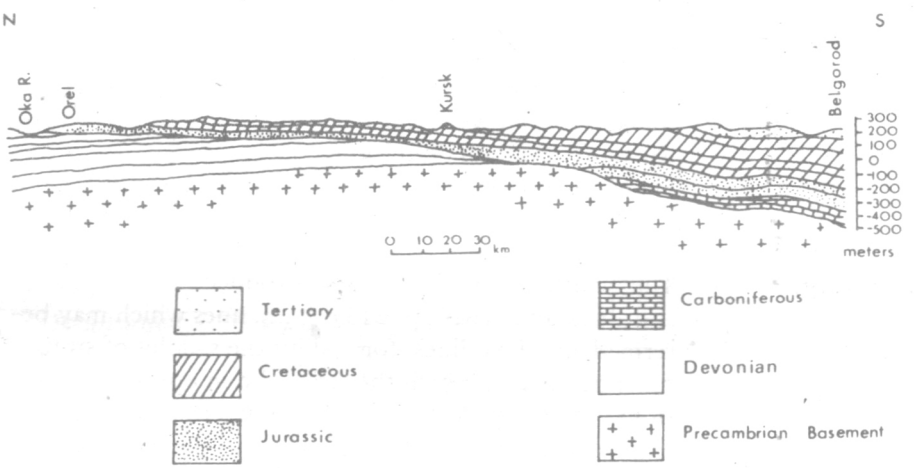

Fig. 1

Anticline

English: Anticline
French: Anticlinal
German: Antiklinale, Antikline, Sattel
Italian: Anticlinale
Russian: Антиклиналь
Spanish: Anticlinal

1. Derivation: Greek *anti,* against; *klinein,* to slope.

2. Definition: A fold with a core of stratigraphically older rocks.

3. Current usage:
English: Follows definition (see Bailey, 1960, p. 33).
French: Follows definition; many French authors continue to use this term in place of "antiforme" (q.v.).
German: Follows definition; see Antikline, Antiklinale, (geologischer) Sattel, in Murawski (1976).
Italian: Follows definition.
Russian: Follows definition.
Spanish: Follows definition. For Spanish usage, see Novo (1957) under "Anticlinal".

4. History: The qualifier "anticlinal" was introduced by Conybeare and Buckland (1824, p. 213): " . . . lines which may be termed anticlinal lines, formed by the saddles of strata on either side of which the strata dip in opposite directions." J. Phillips (1837, p. 39) adopts the same usage, emphasizing that "anticlinal" refers to the crest line only, the complete fold being termed a "saddle". "Anticlinal – applies to strata which dip in opposite directions from a common ridge or axis, like the roof of a house, and [which] form what is termed an anticline or saddleback" (Page, 1865, p. 88). "Anticlinal" at that time was used as an adjective, but was shortened by some to the noun form "anticline" which gradually became the preferred term. Lapworth (1883, p. 199) used "anticline" as a synonym for "arch", but also used "anticlinal" (1883, Pl. 5, Fig. 10; Pl. 8, Fig. 1). B. Willis (1893, p. 219) defined an anticline as an " . . . upward convex curve, . . . older strata within domes of . . . younger." As used by Bailey & McCallien

(1937) and Bailey (1960), an anticline is a fold with a core of older rocks.

5. Special note: For a related term which refers to geometrical form, without regard to stratigraphical sequence, see under "Antiform". In the past, "anticline" has often been used as a synonym for "antiform" (q.v.).

6. Illustration: See under "Antiform".

Anticlinorium

English: Anticlinorium
French: Anticlinorium
German: Antiklinorium
Italian: Anticlinorio
Russian: Антиклинорий
Spanish: Anticlinorio

1. Derivation: Anticline, and Greek *oros*, mountain (Dana, 1873).

2. Definition: A composite antiform, consisting of several subsidiary folds.

3. Current usage:
English: Follows definition.
French: Follows definition.
German: Follows definition; see Murawski (1976) under "Antiklinorium".
Italian: Follows definition.
Russian: Follows definition.
Spanish: Follows definition. For Spanish usage, see Novo (1957) under "Anticlinorio".

4. History: "This brings us to another important distinction in orographic geology – that of a second kind of monogenetic mountain. The *synclinoria* were *made through a progressing geosynclinal*. Those of a second kind, here referred to, *were produced by a progressing geanticlinal*. They are simply the upward bendings in the oscillations

of the earth's crust – the geanticlinal waves, and hardly require a special name. Yet, if one is desired, the term *anticlinorium,* the correlate of *synclinorium,* would be appropriate" (Dana, 1873, p. 431). Van Hise (1896a, p. 607) states: "All folds . . . when not simple, are called, following Dana, *anticlinoria* and *synclinoria*." However, here Van Hise is not following Dana but is, in effect, redefining the term in the morphelor gical sense. Leith (1914, p. 105) follows Van Hise: "Anticlinorium and synclinorium refer to composite arches and throughs." The same usage is given by Willis & Willis (1934), and by most writers to this time, i.e. the term is now purely descriptive.

In the U.S.S.R. the term is both genetic and descriptive, and latter sense being much more common. Some Soviet authors restrict the meaning of "anticlinorium" according to history and rate of development, position in the structure of a geosynclinal and folded area, its interior structure, dimensions, etc. The majority of these special definitions are not in common use. The most generally accepted Russian definition classifies anticlinoria genetically as "inherited" or "uninverted" (formed on the site of geanticlines) and "inverted" (formed on the site of geosynclines) (Beloussov, 1954; Bogdanov et al., 1963)

Examples: the Uraltau anticlinorium (the Urals), the main Koper-dag anticlinorium.

5. Special notes: Commonly used at a scale of tens or hundreds of kilometers. A grouping of several anticlinoria into a larger structure is called "meganticlinorium" in Russian (мегантиклинорий).

6. Illustration: From DHT.

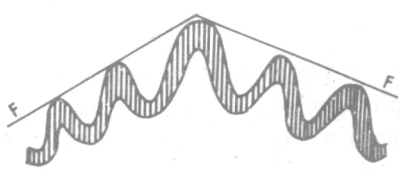

Fig. 2 F = Fold Envelope

Antiform

English: Antiform
French: Antiforme
German: Antiform
Italian: Antiforme
Russian: Антиформа
Spanish: Antiforma

1. Derivation: Greek *anti,* against; and form.

2. Definition: Fold which closes upward. (Geometrical term. Used without regard to stratigraphical sequence).

3. Current usage:
English: Follows definition (see Bailey & McCallien, 1937, p. 80).
French: Follows definition. Synonymous use of "anticlinal" (q.v.) still common.
German: Follows definition. Synonymous use of "Antiklinale" and "Sattel" (see under "Anticline") still common. See also Murawski (1976) under "Antiform".
Italian: Follows definition.
Russian: Follows definition.
Spanish: Follows definition.

4. History: Heim (1878, v. 2, p. 195) distinguished between true (stratgraphic) anticlines, and forms which close upward (*Sattel*). Bailey & McCallien introduced the English equivalent for *Sattel,* which is used for upward-closing folded surfaces where the term "anticline" in its true stratigraphic sense cannot be applied. First American use in the above sense is in the legend of the 1961 Geological Map of New York (New York, 1962).

5. Special notes: See also under "Anticline".

6. Illustration: from Dennis (1967, Fig. 1).

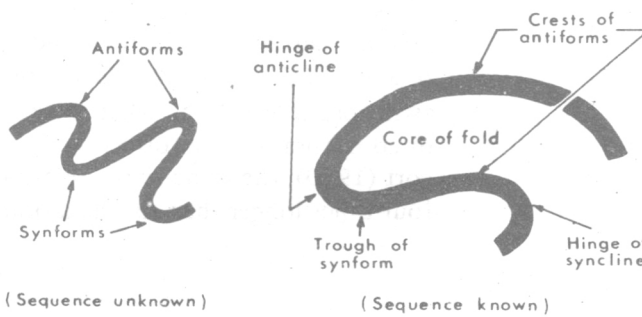

Fig. 3

Asthenosphere

English: Asthenosphere
French: Asthénosphère
German: Asthenosphäre
Italian: Astenosfera
Russian: Астеносфера
Spanish: Astenosfera

1. Derivation: Greek *asthenes*, weak; *sphaire*, sphere.

2. Definition: Shell of assumed greater plastic yielding in the mantle, in contrast to the less yielding lithosphere (q.v., definition 2) above, and mesosphere below.

3. Current usage:
English: Follows definition. (See Barrell, 1914, p. 657, and Isacks et al., 1968, p. 359).
French: Follows definition.
German: Follows definition. Introduced by Born (1923, p. 11). See Murawski (1968–1979) under *"Asthenosphäre"*.
Italian: Follows definition.
Russian: Follows definition.
Spanish: Follows definition. See Novo (1957) under *"Astenosfera"*.

4. History: Barrell (1914, p. 659) proposed the term because: "The theory of isostasy shows that below the lithosphere there exists in contradistinction a thick earth-shell marked by a capacity to yield readily to long-enduring strains of limited magnitude. . . . Its comparative weakness is . . . its distinctive feature. It may then be called the sphere of weakness- *the asthenosphere* . . . " Gutenberg (1955, p. 19) by implication defined asthenosphere (in contrast to lithosphere) as a region at depths having a yield strength of less than $10^9 \pm$ dynes/cm^2: " . . . the transition from the lithosphere to the asthenosphere is gradual, without a definite boundary." Bucher (1955, p. 344), in the same symposium, places the top of the asthenosphere at " . . . what the geodesist calls the 'level of compensation' (± 100 Km) . . . " According to Walcott (1970), the asthenosphere can be considered a fluid four times longer than its relaxation time. Jeffreys