REGIONAL STABILITY AND EARTHQUAKES

STABILITÉ RÉGIONALE ET SÉISMES

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Summary:

Regional stability is referred to as the degree of stability affected by crustal activity, especially earthquakes and some geophysical phenomena induced by them, such as fault activity, rock fall, landslide, sand-liquefaction, clay-plastic-flow, surface subsidence, etc. Thus earthquakes are the first and the most important factor affecting regional stability.

From the geomechanical point of view, this paper deals with firstly the tectonic history so as to decide the new or recently active tectonic systems and faults and the present tectonic stress field. On the basis of the summarized characteristics of earthquake systems and faults and the migration of epicenters, three elements of earthquake prediction are proposed. The geophysical phenomena induced by the earthquake are discussed, dealing with their relation to earthquake intensity and intensity attenuation in the surroundings of an epicenter under certain geological, especially structural conditions. Finally the author puts forward the principles of regionalization of regional stability. Considering the degree of regional stability, a region is divided into districts, zones, sections and sites in descending order of magnitude. This offers the basis for site selection, since a stable site can be dialectically selected in an unstable district.

Résumé:

La stabilité régionale est en rapport avec le degré de stabilité affecté par l'activité crustale, en particulier par les séismes et certains phénomènes géomorphologiques qu'ils engendrent: réactivation de failles, chutes de roches, glissements de terrains, écoulément plastique des argiles, affaissement de la surface du sol, etc. Aussi, les tremblements de terre constituent le premier et le plus important facteur d'altération de la stabilité régionale.

Au point de vue géomécanique, cette étude s'intéresse en premier lieu à l'histoire tectonique, a fin de reconnaître quels sont les systèmes tectoniques et lesfailles, nouveaux ou récemment actifs, et les champs de contraintes tectoniques actuels. En s'appuyant sur le résumé des caractéristiques des systèmes de séismes, des failles et des déplacements des epicentres, on propose trois éléments de prévision des séismes.

On discute les phénomènes morphologiques engendrés par les séismes: relation avec l'intensité du séisme, atténuation de l'intensité aux alentours d'un épicentre dans certaines conditions géologiques, structurales en particulier.

Finalement l'auteur pose les principes d'une régionalisation de la stabilité régionale. Considérant le degré de stabilité régionale, une région est divisée en districts, zones, sections et sites, par ordre de grandeurs décroissantes. Ce qui offre le fondement d'une sélection des sites, car un site stable peut être choisi dialectiquement dans un district instable.

Preface

Regional stability is defined as the degree of stability of a region which may be affected by crustal movements exhibited by differential vertical displacement and horizontal movement, volcanic activity, fault activity, especially those strong activities which may induce earthquakes in one area and those possibly breaking out in adjacent areas, and consequent regional geophysical processes such as fault activity, rock falls, landslides, sand-liquefaction, clay plastic flow, and uneven surface subsidence.

It is obvious that there are many factors affecting regional stability. They are stratigraphy, rock properties, geological structure, neotectonic activity, earthquake, etc., among which earthquake is the main factor. So it is necessary to focus our attention on earthquake in the research work of regional stability. As a matter of fact, since tectonic and shallow earthquakes are predominant in China, they become the point we concentrate upon.

In this paper, an attempt is made to analyse regional stability from a geomechanical point of view. Active tectonic system and faults, especially the present tectonic stress field are dealt with.

Analysis of Regional Stability

1. Analysis of Tectonic History

To analyse the stability of a region, we must first recognize the various types of tectonic systems and their compounding relationships, and determine their occurrences and periods of development with regional geology taken into consideration. In this way we may determine the systems occurring recently or still active. This is because the action of a tectonic system is great and may often induce earthquakes. As for judging whether a tectonic system is active, we take mainly the activities of its individual components into consideration. Since a tectonic system is formed under the action of a certain tectonic stress field, the whole tectonic system may be either active in different degrees, if the present stress field is just the same as its original, or only partly active if to the contrary. It is, therefore, necessary to further determine the present active tectonic stress field when certain components of a system have been found to be active. That is to say, in a certain region, the active tectonic system must be recognized on one hand, and, on the other hand, what is more important is to find out the active tectonic stress field, which may enable us to confirm more accurately the activities of the tectonic system and faults and the place where the stress is apt to be concentrated and earthquake is apt to take place.

Geomechanics holds that the formation of tectonic stress fields is much related to variation in the rate of the earth's rotation. Available seismic data indicate that due to the high speed of the earth's rotation, there have been in North China tectonic stress fields represented by the E-W structures and Hohsi tectonic systems, in SW China by the N-S structures and Tibet-Yunnan \( n \)-type tectonic system; and due to the slow speed there have been tectonic stress fields represented by Neocathaysian and Cathaysian systems in East China.

2. Analysis of Earthquake Structures

From the viewpoint of tectonic systems (Fig. 1), past earthquakes often developed in connection with shear structures, such as \( e \)-type, Neocathaysian, \( n \)-type and with shear planes of E-W and N-S systems. It should be noted that earthquakes do not occur everywhere within a...
Fig. 1: Plans Showing Type of Tectonic Systems

(A) East-West Tectonic Systems
(B) North-South Tectonic System
(C) Cathaysian Tectonic System
(D) North-West Tectonic System
(E) Neocathaysian Tectonic System
(F) Hohsi Tectonic System
(G) σ type of structure
(H) λ type of structure
(I) Lineament type of structure
(J) Brush type of structure
(K) Turbine type of structure
(L) Lotus type of structure
(M) Reverse 'S' type of structure
(N) 's' type of structure
(O) τ-type

Linear systems
Shear systems
Torsional systems

Compressive structural plane
Tension structural plane
Shear structural plane
External force
Torsional force

Compressive stress
Tensile stress
Relative slipping direction in shear structural plane
Mainstay or eddy