
Research History and Current Situation of the Development of Structure Physical Modeling Experiment

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Abstract: The structure simulation experiment is to study and mimic natural geological structure deformation characteristics, genetic mechanism and dynamics process of a physical experiment method. Theoretical basis of physical simulation of structure, development process and present situation is to get people's attention.

Keywords: structural physical simulation; the study of history; the status quo.

RESEARCH HISTORY

In the long ago, people through geological mapping method of tectonic geometry and kinematics features of crustal rocks deformation accumulated a lot of perceptual knowledge. By observing the deformation characteristics of the structure of different forms in the process of tectonic deformation and deformation conditions have a certain understanding, but this kind of understanding based on some kind of speculation only due to tectonic deformation in the process of long, people can see is just the result of the crustal tectonic deformation of rocks, but can't observe the whole process of tectonic deformation, therefore the mechanics mechanism of tectonic deformation process and a number of important basic problem can't really understand. So people invented structure physical modeling experiment method, use models to represent the tectonic deformation, thus study observed in the nature of the tectonic deformation process. Structure physical modeling experiment research history, the earliest can be traced back to at the beginning of last century, which can be roughly divided into three main stages of development [1].

The initial stage

The initial stage from the early 19th century to the end of the 19th century, for the early stages of development of physical simulation. At the time, because of rock properties is poorly understood, plus the lack of mature similarity theory, basically does not consider similar conditions in the experiments. Model adopted by the materials including zinc, iron, aluminum and other metal materials, clay, plaster, glass, soap, cloth, paper and other non-metallic materials, and gypsum, a mixture of wax, cypress oil, turpentine oil, etc.

HALL, the earliest use multilayer fabrics with close clay geosynclinal sediments by level between the neighboring plots after extrusion deformation mechanism research of simulation experiment was carried out. French scholar Daubree glass sheet was studied by reverse rupture experiments, prove the existence of the joint set of deformation and shear fracture and tensile fracture surface of solid sex at the same time, and the rock cleavage, fracture, joint and fold the experiment are summarized. First put forward by German Reyer deep effect caused by the earth's crust uplift and slope, layered rock along the slope sliding of gravity theory, to explain the fold formation. But according to his theory of gravity gliding fold a simulation, but also to the sausage, echelon construction crack, horst and graben structure the concentric circles structure of solid build, radial test simulation, and the phenomenon of the structure of the magma intrusion and volcanic eruptions are simulated experiment, especially for the first time, he puts forward the problem of constructing model similar conditions, think with scale and time is much smaller than the actual geological model to represent the tectonic deformation, the use of material viscosity must be much lower than the viscosity of the rock. As a result, he USES the model of material for wet clay, gypsum, clay, gypsum, syrup and the mixture of gelatin gelatin layer and all kinds of powder, clay. The United States geological survey of the Willis with plaster of Paris as hard layer, beeswax as soft layers of experimental geological model, simulates the Appalachian mountains of folding, and proposes the incompetent bed is not easy to fold through the simulation experiment and rock layer is easy to fold. But in the experiment, he needs to put a lot of model under overlying load, and the Appalachian mountains of overlying situation, he adopts the experimental materials or too hard. In general, this stage belongs to the tectonic simulation experiment primary

stage of development. On the structural view, mainly associated with the contraction of the earth hypothesis, on the model selection of materials, and there is no similarity considerations [2-4].

Important stages

The important stage in the first half of the 20 age period is important stages in the development of simulation experiment. Sheldon to test shear joint did many experiments and a joint surface properties. Morath in his doctoral thesis, quantitative theory was applied to construct model of dimensional analysis is used to calculate the strength of the geological material factor, points out that if a given length factor, the strength also should be reduced the same factor. Hobbs the existing data and combined with simulation experiments on the formation mechanism of the Alps have done a lot of work. Mead think fold belt formed through the experiment in many cases may be formed by the shearing action. German Cloos did many experiments with mud, simulates the scale smaller tectonic deformation, due to conform to the principle of similar effect is very good, is one of the most successful simulation of fracture mechanism, he also has been simulated Rhine graben, the red sea rift valley, etc., and argues that the graben or rift is caused by the earth's surface tension and so on. Article DE Seth, rubber, clay, wax, such as do the experiment, think the shorter parallel strata is produced with heart the cause of the fold. With the deepening of the research structure physical modeling experiment, the simulation experiment of physical similarity theory also continuously improved. As early as 1913, Hubbert is put forward, in the model if the deformation measurement is one million times, so in the case of medium density is constant, dielectric strength also should be reduced as much as one million times. Think to simulate with experiment materials of rock under high temperature and high pressure, the most important is similar on the viscosity. Nettleton and Dobrin with asphalt and syrup in the United States made on salt diapiric dome forming process of the experiment, and the experiment of physical similarity to do a very good explanation, salt dome is formed by rock salt gravity floatation flow point of view, this makes the simulation experimental work a step forward greatly. In the former Soviet union, don't lo wu soff system simulation experiment is made, in 1944; he in the theory of tectonic lab simulation experiment was carried out. Founded in 1949, the Soviet Union academy of sciences, institute of geophysics structure physics laboratory, on the transverse bending, buckling, boudinage cleavage has carried on the experimental study, etc. These jobs are in the vertical force plays a leading role in the overall point of view [5 8 9].

Stage of development

A new stage of development, since the 1950 s, simulation experiment has entered a new stage of

development. On the one hand, the simulation experiments carried out in many countries widely; on the other hand, simulation experiments are no longer satisfied with the form of representation, but constantly working in quantitative direction.

In 1944, the Soviet Union under the leadership of the don't lo wu soff tectonic laboratory, the Soviet Union first theory to construct physics research. , such schemes based on the 1950 into the Soviet academy of sciences, institute of geophysics (and later the Soviet academy of sciences, institute of physics, the earth) and the structure of the physics laboratory work, lattice zoff and don't lo wu soff etc. To a large extent determines the development direction of the former Soviet union structure physics. They made in the laboratory of different types of fold, fault and sausage structure, and studied the various influence factors of quantitative estimates. To construct the theoretical basis of simulation and experiment methods to carry on the further system research, will determine the conditions of similarity dimensionless method introduces structure simulation study. Lattice pad, starting in 1953 the introduction of the photoelastic method, analyzes the simple shear stress distribution and longitudinal bending fold, the structure model of stress research has entered a new stage of quantitative analysis. In don't lo wu soff and pad co-authored book experimental structural geology in has carried on the preliminary summary to the development, and in 1975 published the "structural physics foundation" to construct the basic principle of simulation experiment, similar condition, the optical method of equivalent material, the model is used to study stress, etc were described in detail. To close to the 21st century, American scholars continue to carry out the salt dome structure simulation, studied on the uplift background fields willing to the formation of the process. To try to simulate crustal deformation in the global scale. In the years from the university of Chicago to Sweden,. In Uppsala University established a laboratory centrifuge construction, realizes the quantitative centrifugal force loading of the model, gravity structure for the original research, has achieved fruitful results, attracted geologists to the laboratory in the rest of the world to visit. So far, the centrifuge structure simulation laboratory and constantly have new experimental results [6].

CURRENT SITUATION OF THE DEVELOPMENT

Tectonic deformation on mechanical belong to the category of large deformation, the establishment of the mechanics equation is more complex, at the same time for long time, under the condition of low strain rate of tectonic deformation of rock deformation characteristics of understanding is not enough full, about the mechanics of rock structural deformation equation is not perfect enough, so the application of mathematical simulation method and a lot of difficulties. Despite

trying so far is comparatively mature in the engineering mechanics analysis of finite element analysis method is used in the study of tectonic deformation, but there are still many problems. The physical simulation still is the study of tectonic deformation process and mechanism problems more effective method, although this method is complex, with no computer simulation calculation of the shortcut convenience [7].

In recent years, due to the continuously introduce new technologies, new methods, structure physical modeling experiment research many important new progress, especially in the studies of oil and gas basin structure has achieved remarkable results. Through the structure physical modeling experiment to study the formation process of oil and gas basin structure and genetic mechanism provides the basis, and for those who only shallow data, data quality is not high, or the lack of deep data of seismic profile interpretation provides patterns and thought. As a result, this method is paid attention to by the oil companies and the development of rapidly. Such as the UK, university of London, geology McClay and Ellis team published dozens of article has influence. Such as extrusion structure is divided into forward extrusion, oblique extrusion, complex boundary and differences between the base plate extruding, etc. In the United States at the University of Texas at Austin and the University of Minnesota and the Massachusetts institute of technology, university of Manchester in the UK, the Australian national university, queen's university in Canada, Sweden and other international well-known university, Uppsala University in structural physical simulation research also has a good research report.

In the sand box experiment made some new progress. Some new methods such as: the principle and method of using the method of brittle coating, faulting and joint interval simulation research. X-ray radiography used to observe the profile of sand box test model also has a lot of improvement in the experimental loading device. Internal structure measurement and 3 d reconstruction technology, finite element discrete element simulation technology. The internal structure measurement technology, including mold biopsy, CT scan, seismic reflection imaging. And so on are used to construct physical simulation [7-9].

But structural physical simulation is an important means of study of tectonic deformation mechanism, has been widely used in all kinds of structure formation mechanism research. But relatively weak in compressive shear tectonic research. Once with a soft material such as Casas of loose sand and double model to study the different extrusion direction characteristics influence on the formation pressure structure, with soft material such as Tikoff research basement extrusion direction under the condition of uniform shrinkage effects on compressive shear structure. The study of

compressive shear structure is relatively shallow, twist the characteristics of structure formed under the condition of pressure to do in-depth research. In view of the salt structure physical modeling is nearly 20 years. Although the geological home salt structure to simulate the different geological conditions, such as under the background of regional extension of salt structure, sedimentary difference load caused by salt, salt lower active fault caused by salt tectonic], etc. But for extruding zone structure load caused by salt or lateral extrusion pressure relatively few physical simulation [8 9].

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