

Geologic structure, relief, and neotectonics of the Chulyshman Upland (*Gorny Altai*)

I.S. Novikov^{a,*}, E.M. Vysotskii^a, S.A. Kargapolov^{a,b}

^a V.S. Sobolev Institute of Geology and Mineralogy, Siberian Branch of the Russian Academy of Sciences,
pr. Akademika Koptyuga 3, Novosibirsk, 630090, Russia

^b Novosibirsk State University, ul. Pirogova 2, Novosibirsk, 630090, Russia

Received 17 June 2015; received in revised form 15 December 2015; accepted 29 January 2016

Abstract

The Chulyshman Upland is a big mountain structure at the boundary between the Altai and West Sayan mountain ranges. It is composed mostly of metamorphic rocks of the greenschist, epidote–amphibolite, and amphibolite facies as well as several large granitoid massifs. The upland stretches for 150 km to the northwest and is ≤ 50 km in width. The main divides are flattened and are almost 3000 m (or, seldom, slightly more) in height. The southwestern and northeastern boundaries of the upland are formed by recent dextral strike-slip faults, and the northwestern and southeastern boundaries, by reverse faults. Neotectonic structures of lower rank divide the upland into four mountain massifs similar in morphology and size; the mountain massifs, in turn, are divided into altitude stages. Recent E–W trending faults are reverse, whereas N–S trending faults are normal. Horizontal displacements along the dextral strike-slip faults are >2000 m, while vertical displacements along the reverse and normal faults are within 150–500 m. There is no contemporary glaciation on the upland. In the Pleistocene, the upper stage of the relief was occupied by ice sheets, which left numerous traces of exaration. The middle stage was a transit zone for the outlet tongues of ice sheets; here, moraine deposits cover the bottoms and slopes of valleys. The lower stage was a zone of moraine accumulation in the Pleistocene. In the Holocene, neotectonic activity in the area was expressed as numerous earthquakes, which have left traces in the form of rock slides at the base of 20% of the extension of the sides of glacial valleys and seismogenic trenches 80 to 2300 m in length. Studies have revealed a pleistoseist zone ($50^{\circ}37'10''$ N; $88^{\circ}51'08''$ E) from a recent (about 200–300 years ago) catastrophic earthquake.

© 2016, V.S. Sobolev IGM, Siberian Branch of the RAS. Published by Elsevier B.V. All rights reserved.

Keywords: geomorphological survey; genetically homogeneous surfaces; seismic geology; metamorphic rocks; Gorny Altai

Introduction

The Chulyshman Upland is located in northeastern Gorny Altai, between Shapshal Ridge (West Sayan) and Ulagan Plateau (Gorny Altai). A strongly elongated rhombus, the upland stretches northwestward, between Dzhulukul' and Teletskoe depressions. Its length is ~ 150 km; width, 30–50 km; and area, ~ 4490 km². The flattened summit surface is divided by wide but shallow forms of glacial plowing, and its altitudes vary within a narrow range of values (2200–2500 m in the northern part and 2700–3100 m in the central and southern ones). The southwestern boundary of the upland is formed by the Chulyshman valley and the valley of the Karakem River, which continues it in the southeast. The upper reaches of the Chulyshman River, as well as the Shavla and

Chul'cha Rivers (its right tributaries), pass across the Chulyshman Upland and divide it into four rhomboid massifs similar in size and morphology, which have a three-stage structure. The Chulyshman Upland is not a regional divide; it belongs almost completely to the Chulyshman basin. The northeastern boundary of the upland includes the Teletskoe, Saigonysh, and Dzhulukul' basins and the valley-like tectonic depressions connecting them, which are used at places by the Saigonysh, Yakhhan-Soru, and Artysh Rivers, assigned to the basins of the right tributaries of the Chulyshman River (Fig. 1). Most of the valleys in the territory, including the Chulyshman valley, are troughs into whose bottoms present-day watercourses are incised. Numerous shallow lakes are located in exaration basins at the upper stage of relief, whereas rare moraine-dammed lakes are observed predominantly at the middle stage of relief.

The Chulyshman Upland is the least studied territory in Gorny Altai. There are no populated places or motorroads in the area. Land cargo traffic is possible only by pack transport

* Corresponding author.

E-mail address: novikov@igm.nsc.ru (I.S. Novikov)

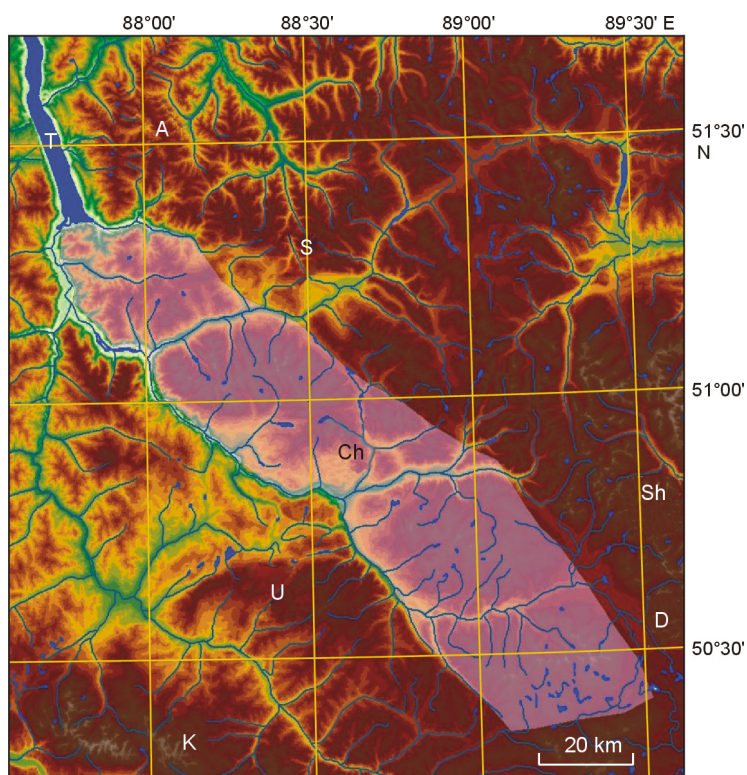


Fig. 1. Scheme showing the position of the Chulyshman Upland in the orographic structure of northeastern Altai. Ridges: A, Abakan; Sh, Shapshal; K, Kurai; upland: Ch, Chulyshman; plateau: U, Ulagan; intermontane basins: T, Teletskoe; D, Dzhulukul'; S, Saigonysch.

along a sparse path network. The small settlements in the Chulyshman valley (Balykcha, Kokpash, and Yazula) have been connected to Ust'-Ulagan by stabilized soil roads over the last 15 years; they had no steady automobile communication before. With their numerous rapids and waterfalls, the Chulyshman River and its main tributaries are not everywhere suitable even for rafting. In 2013–2015, we carried out field geological and geomorphological studies in the region, which yielded a more detailed picture of its geologic structure, morphology and evolution of relief, and recent tectonics. The paper presents new data on this interesting but poorly studied region.

State of geological and geographical knowledge of the territory and its topographical and geological surveys

The first topographical maps of the Chulyshman Upland were compiled using stereophotogrammetry by the Military Topographical Survey in the late 1940s. Earlier there had existed only pre-Soviet sketch maps, scale 1 inch/10 versts, which corresponded approximately to 1:420,000. A new topographical survey was done by the Chief Department of Geodesy and Cartography of the USSR Council of Ministers in 1960. It served as a basis for topographical maps of all succeeding scales (1:25,000–1:1,000,000), and large- and medium-scale topographical maps have not been renewed ever since. Georeferenced high-resolution satellite images of the

Chulyshman Upland have appeared in open access in recent years, but the mistie reaches 150 m. The name of the study area has not been completely established: It is most often called the Chulyshman Upland (on maps of scales 1:2,500,000, 1:200,000, and 1:100,000), the Chulyshman Plateau on maps of scale 1:500,000, and the Chulyshman Ridge on older maps. We use “the Chulyshman Upland” as the name best describing the geomorphologic structure of the territory, which consists of four isolated mountain massifs.

In the 19th and early 20th centuries, many researchers, starting from P.A. Chikhachev (On the work..., 1845), visited the Chulyshman Upland. They left unsystematic notes on the relief of the territory, which are of only historical interest today. The first serious geological and geomorphological study of the upland is the extensive essay of L.I. Semikhatova (1934). It is a detailed description of her long equestrian circular route from Lake Teletskoe to Dzhulukul' basin and back, which has completely retained its scientific value. In a later study of the region, M.S. Kaletskaya (1938, 1948) was the first to distinguish three main altitude stages of regional relief and observed the detachment walls of enormous seismogenic rock slides in the Chulyshman valley.

Geological survey on scale 1:200,000 was done in the study area in the 1950s. The compiled maps and explanatory notes to them were published in the early 1960s (Dergunov et al., 1961; Kolesnikov et al., 1963). No prospecting or surveying works have been carried out since then. Geomorphological maps on a scale of about 1:333,000 are presented in explanatory notes to sheets of geological maps. Also, a set

Download English Version:

<https://daneshyari.com/en/article/4738675>

Download Persian Version:

<https://daneshyari.com/article/4738675>

[Daneshyari.com](https://daneshyari.com)