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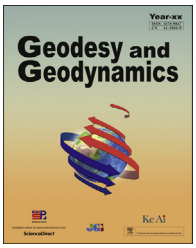

Research on the relationship between geophysical structural features and earthquakes in Mid-Yunnan and the surrounding area

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ABSTRACT

In this study, we analyzed the gravity and, magnetic characteristics, and the occurrence of a fault zone and discussed the relationships between the two locations. The results reveal that the subsurface structures strikes are different compared with those in the research region. In other words, the geophysical advantageous directions from the gravity and magnetic anomalies are not the same as those caused by the surface structures. The local horizontal gradient results from the gravity and magnetic anomalies show that the majority of earthquakes occur along an intense fault zone, which is a zone of abrupt gravity and negative magnetic change, where the shapes match very well. From the distribution of earthquakes in this area, we find that it has experienced more than 11 earthquake events with magnitude larger than *Ms*7.0. In addition, water development sites such as Jinshajiang, Lancangjiang, and the Red River and Pearl River watersheds have been hit ten times by earthquakes of this magnitude. It is observed that strong earthquakes occur frequently in the Holocene active fault zone.

1. Introduction

Since the *Ms*8.0 Longmenshan earthquake that occurred in Wenchuan in 2008, researchers in China and other countries have conducted extensive research from various perspectives on the geophysical background, seismogenic mechanism, and surface rupture [1–3] of the earthquake. The middle of Yunnan and its adjacent area is located on the Yunnan–Guizhou Plateau—the high-frequency and intensity seismic activities in this region, which are obtained for a short

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source, cause destruction and occur for a short duration. History records 46 events >Ms6.0 in magnitude, six events >Ms7.0, and one event >Ms8.0. The study area is located on a southeastern slope in the uplift zone of the Tibetan Plateau. As for the tectonic setting, the terrain is high in the northwest and low in the southeast. The deep faults in the region are developmental and located in the north-west, north-south, and north-east regions. In particular, the Nujiang, Lancangjiang, Chenghai, Yuanmou-Lvzhijiang, and Xiaojiang Faults occur in the north-south; the Jinshajiang and Red River Faults occur in the north-west; and the Zhongdian–Qiaohou, Lijiang–Jianchuan, and Nanting Faults occur in the northeast. In addition, the research region is at the frontier where the Indian Plate pushes into the Northeast Chinese mainland, making the whole region structurally complex and thereby resulting in significant changes in its geophysical features. It is generally recognized that this modern tectonic framework and the collision of the Indian–Eurasian Plate are closely related to the uplift of the Tibetan Plateau [4]. Few researchers have produced crust or lithospheric seismic velocity perturbation images [5–7] and electrical structure images [8–10] of this observation. The distribution of low-speed, low-resistivity bodies in the middle and lower crust shows that viscosity and material flow channels exist thus providing intuitive evidence for a lower crustal flow configuration mode [11–14]. Ma Zongjin et al. [15] suggested that mainland China earthquakes, especially strong ones, occur within the crust at a certain advantageous layer called the "multi-shock layer." They also observed that the effect of earthquake fracturing and earthquake occurrence shows a layered distribution.

Previous studies have analyzed gravity, magnetic, and electrical anomalies in Western Yunnan and the Red River fault zone [16,17]. These have resulted in gravity and magnetic zoning characteristics, crustal thickness determination, and estimates on the extent of the Red River Fault. Based on previous works, this study investigates gravity and magnetic anomalies in central Yunnan and its adjacent area (23°N–27°N, 100°E–105°E) as well as discusses the relationship between the geophysical features, watercourses, and earthquakes in this region.

2. Geological and geophysical characteristics of the study area

2.1. *Regional geological feature*

There are numerous active faults in the study area, and detailed research has been conducted on each important fracture [18]. In the Xiaojiang fault zone, the Anninghe Fault exhibits a left-lateral strike-slip and the Red River Fault exhibits a right-lateral strike-slip. When undertaking research, structural fault strike-slip and geological characteristics are prerequisites of geophysical work. If there is no comprehensive and systemic testing of the physical parameters, geological exploration would not be reasonable. In this study, we briefly analyze geological age (Fig. 1), faults, and lithology based on the geological map compiled by Deng Qidong. There are two primary tectonic plates in the research region: the Indian Plate and the Yangtze Plate. The Indian Plate lies between the Lancang River Fault and Red River Fault and is composed of a continental nucleus—the Kunsong Block of the eastern Vietnam boundary—and a multiple-period edge fold belt. The Red River Fault and the Yangtze Plate converge at the Sinian–middle Cambrian. Furthermore, the Yangtze Plate is located in the north of the Red River, and the Yangtze Block is a continental nucleus of ancient land where its base is a Proterozoic metamorphic rock series overlain by the Sinian molashi and an early Paleozoic platform. In addition, the late ancient Paleozoic and Mesozoic deposits exhibit

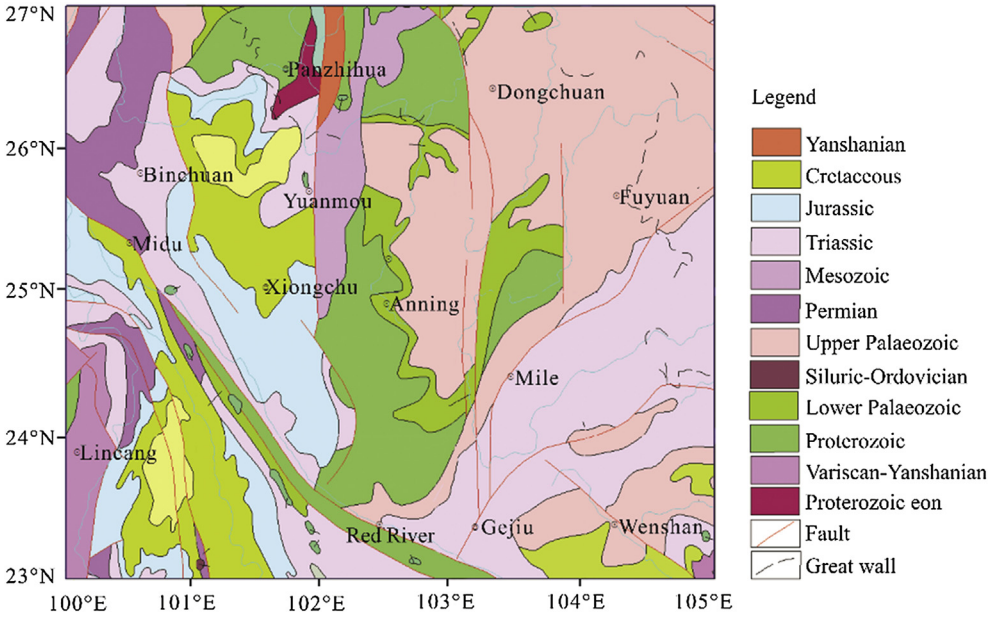

Fig. 1 – Geological setting and fault distribution.