Gravity anomalies and granite emplacement in west-central Colorado

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ABSTRACT

A major negative gravity anomaly with a minimum of −325 mgal and an amplitude of −70 mgal occurs in west-central Colorado between Aspen and Gunnison. The gravity minimum is closely associated spatially with Late Cretaceous to Oligocene granitic rocks and continues along the Colorado mineral belt to the northeast. Gradients indicate that the source of the negative anomaly is in the upper crust, but part of the negative anomaly is attributed to crustal thickening that is a result of isostatic compensation. The most plausible explanation for the negative gravity anomaly is that most of it is caused by a granite batholith 8 to 25 km thick and that the numerous granitic stocks in the area are protrusions from this batholith, so that the mineral belt occurs along the roof zone of the batholith. Although the stocks appear to have been emplaced primarily by stoping, the gravity effect of the stoped material must be at the base of the crust or dispersed, because the gravity effect is minimal. Temperatures in the lower crust may be high enough for the granite to have been formed by partial melting. The postulated batholith is a major crustal feature that cuts obliquely across many Laramide structural trends. *Key words: solid Earth geophysics, intrusions, crustal structure, Colorado.*

INTRODUCTION

Tertiary granitic intrusive masses coincide with a major negative gravity anomaly in west-central Colorado between Aspen and Gunnison (Fig. 1). "Granite" is used in this paper to mean phaneritic quartzofeldspathic rocks; the composition of most of the rocks ranges from quartz monzonite to granodiorite. The minimum value of −325 mgal is one of the most negative Bouguer gravity anomalies in the United States. Similar negative gravity anomalies associated with Tertiary granite masses that follow the Colorado mineral belt to the northeast have been reported by Case (1965, 1967) and Brinkworth (1971). For the study of such an association, the area offers several advantages: a very large anomaly, granite intruded into sedimentary rocks where structural relations are relatively easy to interpret, and peripheral exposures of Precambrian rocks that reveal something about the nature of the crystalline crust. This study interprets the negative gravity anomaly in terms of granite emplacement and crustal structure.

GEOLOGY

The area studied is shown in Figure 1. Of the major mountains in the region, the Sawatch Range is primarily carved from Precambrian igneous and metamorphic rocks that form the core of an anticline (Tweto and Sims, 1963) associated with thrust faulting. The flanks of the anticline are composed mainly of sedimentary rocks of Paleozoic age. This area was a depositional trough in late Paleozoic time (Langenheim, 1952), and the sedimentary units are 3 km thick in places. Numerous exposures of Tertiary granite range in composition from quartz monzonite to granodiorite or even diorite; these are emplaced mainly as stocks and as the Mount Princeton batholith. These Tertiary intrusive rocks are predominantly in the southern part of the Sawatch Range.

The Elk Mountains (Fig. 1) lie in the above-mentioned Paleozoic basin. The West Elk Mountains consist mainly of Cretaceous and lower Tertiary sedimentary rocks and Tertiary volcanic rocks. Both mountain systems are intruded by Tertiary stocks and laccoliths (Tweto and Sims, 1963).

The northwestern part of the area of Figure 1 is composed mostly of Paleozoic and Mesozoic sedimentary rocks partly overlain by Tertiary volcanic rocks. The area lies within the Colorado mineral belt as defined by Tweto and Sims (1963). At present levels of exposure, the Tertiary granite is found largely in sedimentary

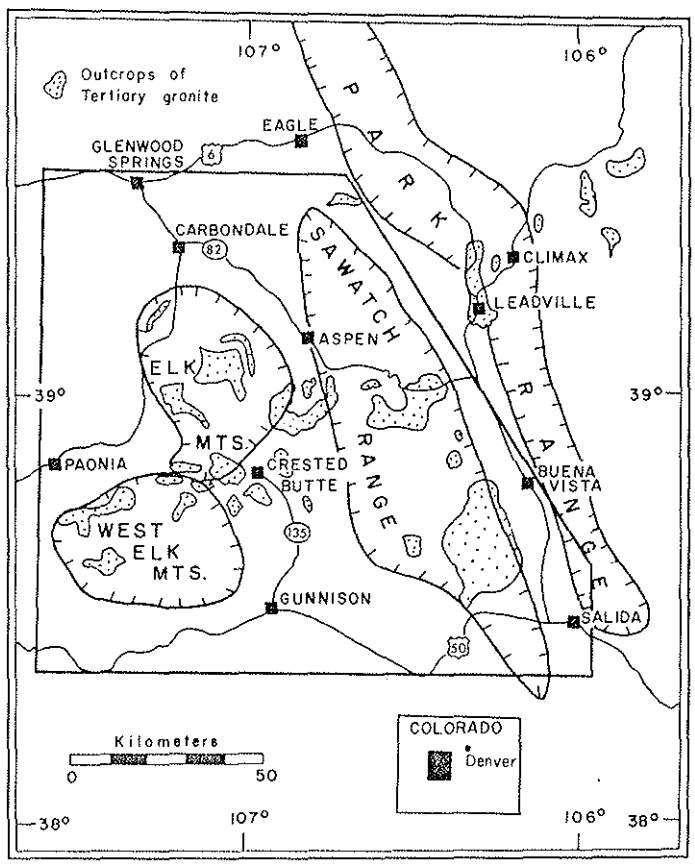

Figure 1. Map of central Colorado. Area of the gravity study is outlined.

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