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Eocene cauldron, batholith, and hydrothermal alteration west of Ketchum, Idaho

by

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ILLUSTRATIONS

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Introduction

In 1982 W. E. Hall and C. M. Tschanz completed compilation of existing geologic mapping for a 1,900 sq km area surrounding Ketchum, Idaho. Much of the data in this compilation resulted from work by Hall, Tschanz, and coworkers carried out from 1970 to 1978 (Hall and others, 1978; Hall and Batchelder, 1979; Batchelder and Hall, 1978; W. E. Hall and C. M. Tschanz, unpub. data). Subsequent additions to this compilation include geologic mapping by R. E. Lewis (unpub. data). Hall was intrigued by the distribution pattern of the Eocene volcanic rocks and associated structures shown by the compilation. The pattern suggested to him that a cauldron might exist in the area west of Ketchum. However, it was clear that further study of the volcanic rocks would be needed before the existence of the cauldron could be confirmed or denied.

A study of the volcanic rocks was carried out during July and August of 1985 by McIntyre. This new work shows that a deeply eroded cauldron does exist in the area west of Ketchum (fig. 1). The new work also shows that a previously undescribed Eocene granitic batholith, only partly deroofed, underlies much of the area northwest of Ketchum. The volcanic rocks and cauldron are surface features related to emplacement of the batholith.

The cauldron

The principal evidence supporting existence of a cauldron in the area west of Ketchum is a downdropped block of rocks bounded by an arcuate fault on the west, southwest, and south (fig. 1). This fault forms an arc with a radius of 8 to 10 km. Where determinable, the dip of this fault is close to vertical.

On the west, the fault juxtaposes dacite and rhyodacite porphyry containing abundant blocks of Paleozoic sedimentary rocks and, in places, amphibolite against altered intermediate-composition lavas intruded by dacite porphyry. The sedimentary rocks belong to the Dollarhide Formation (Hall, 1985); the amphibolite, in thrust fault contact with the Dollarhide, has for many years been informally referred to as the amphibolite of Carrietown (W. E. Hall, unpublished data). The lavas and dacite porphyry form part of the downdropped cauldron block.

On the southwest and south, the fault juxtaposes Paleozoic sedimentary rocks on the outside with andesitic and rhyodacitic lavas on the inside. Locally, small rhyodacitic domes occur adjacent to the fault along the south side.

The cauldron-bounding fault becomes ambiguous when traced toward the north. The cauldron appears to be a trap-door collapse structure, with most of the subsidence toward the south.

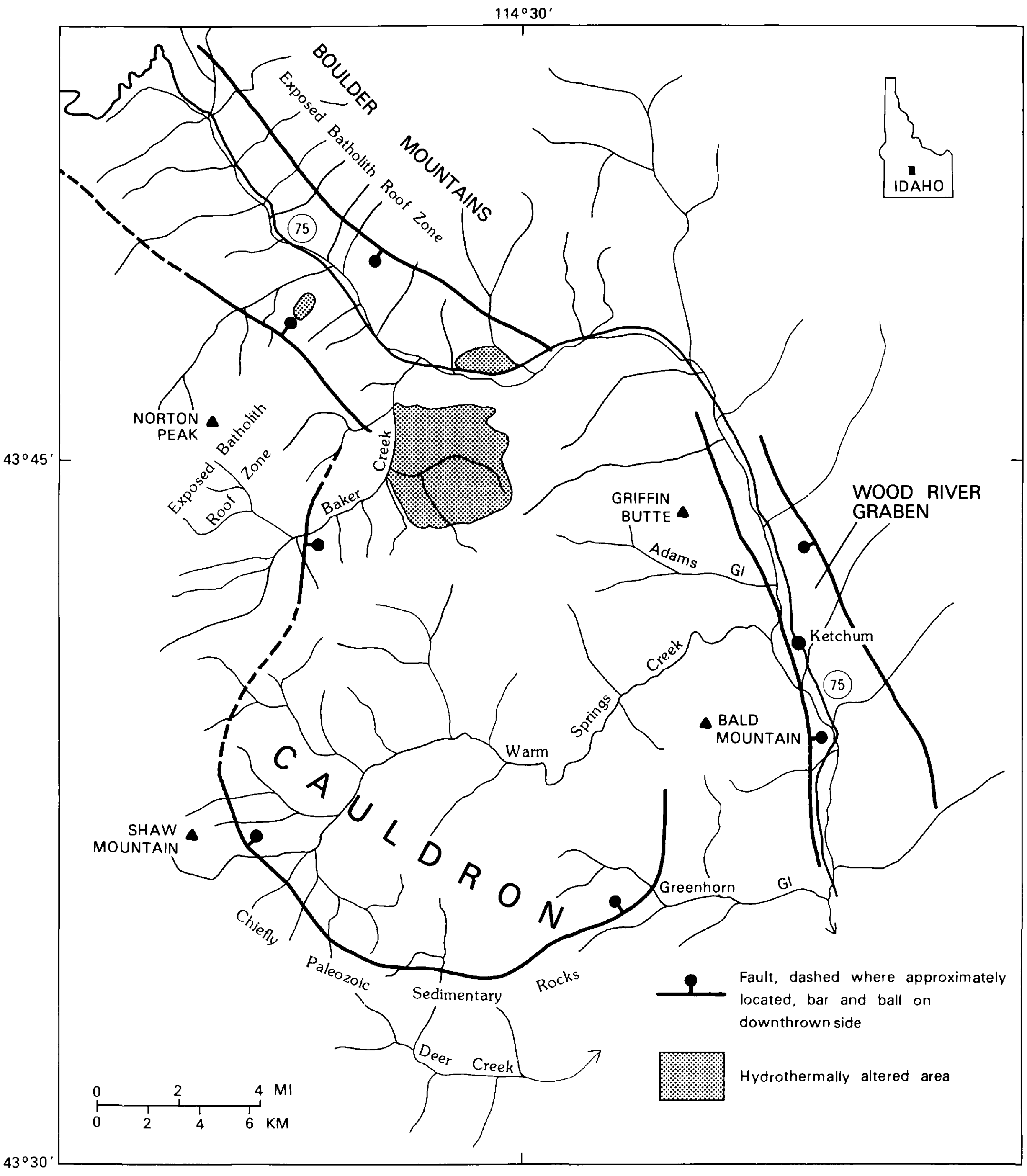

Figure 1.--Diagrammatic map showing volcanic cauldron and selected geologic features near Ketchum, Idaho

Lavas that range in probable composition from andesite to rhyodacite occur both within and outside the cauldron and were emplaced prior to cauldron subsidence. Available evidence indicates that cauldron subsidence was associated with eruption of ash-flow tuff of probable rhyodacitic composition. An interval of erosion of the subsided block preceded an episode of rhyolite intrusion and dome formation along northeast-trending fractures that cut obliquely across the cauldron (fig. 1). Local deposits of nonwelded rhyolitic tephra occur around some of the domes.

Very little ash-flow tuff is preserved in the subsided block; the best example is densely welded tuff of probable rhyodacitic composition that crops out near the southeast boundary of the cauldron where subsidence was greatest. The exposure is in Greenhorn Gulch near the border of a rhyodacitic dome. The tuff rests unconformably on quartzite and limy sandstone of the Wood River Formation and is separated from adjacent andesitic lavas by a fault. Nearby is a steeply dipping, dikelike slab of tuff that may have been a feeder for the ash-flow tuff erupted to the surface. The ash-flow tuff is younger than the andesitic lavas and most likely is younger than most of the rhyodacitic lavas exposed nearby. The tuff, made up chiefly of densely welded brown glass shards and collapsed pumice, contains phenocrysts of plagioclase, amphibole, and biotite. The mafic minerals make up about 10 percent of the rock, with amphibole five times as abundant as biotite.

The subsided block contains, in addition to the volcanic rocks, Paleozoic sedimentary rocks and a small pluton of Cretaceous granitic rock. The widespread exposures of these pre-volcanic rocks in the subsided block indicate shallow subsidence and (or) deep erosion of the block.

The cauldron is small, probably shallow, and probably trapdoor.

The batholith

Eocene volcanic, hypabyssal, and plutonic rocks near Ketchum form a cogenetic sequence related to emplacement of a previously undescribed Eocene granitic batholith. This batholith probably resembles the Casto pluton of the Challis quadrangle (Fisher and others, 1983). It differs chiefly in being only partially deroofed; much of this body still is covered by volcanic and pre-Tertiary sedimentary rocks. Its subsurface extent can be present only be approximated; perhaps future geophysical modelling might be helpful. The cauldron west of Ketchum is an incidental feature produced during batholith emplacement, most likely during an early stage.

Various levels in the upper part of the batholith and its roof zone have been juxtaposed by faulting. The lowest level is represented by dacite and rhyodacite porphyry that, over vast areas, is filled with roof pendants and blocks of Paleozoic sedimentary rocks. Locally, the porphyry is intruded by pink granite that clearly is much younger. These relations are well exposed in the southeastern Boulder Mountains (W. E. Hall, R. E. Lewis, D. H. McIntyre, and Craig Wavra, unpub. data) and in the mountains west of the cauldron (D. E. Stewart, J. K. Geslin, J. B. Mahoney, R. S. Darling, and P. K. Link, Idaho State University, unpub. data; D. H. McIntyre, unpub. data).

The next highest level is represented by dacite and rhyodacite porphyry that intrude volcanic rocks. Commonly also present in minor amounts are rhyolite porphyry intrusions that clearly are the shallower level counterparts of the pink granite. The volcanic rocks in this zone are chiefly rhyodacite lavas and pyroclastic rocks. In some areas, the intrusive and extrusive rocks are texturally identical. They can only be distinguished where cross-cutting relations of the intrusive rocks can be seen, or where zones of bedded tuff or breccia occur between lava flows. The more mafic rocks at this level are analogous to the "gray porphyry" and "diorite complex" rocks that partly surround the Casto pluton in the Challis quadrangle (Fisher and others, 1983).

The highest level, volcanic rocks without hypabyssal intrusions, is best preserved in the cauldron, in the Wood River graben, and in an unnamed graben southwest of the Boulder Mountains (fig. 1). Two sequences of volcanic rocks are readily mappable: an older sequence ranging in probable composition from andesite to dacite that has normal magnetic polarity, and a younger sequence that probably is chiefly dacite and rhyodacite and has reversed magnetic polarity. In Adams Gulch, northwest of Ketchum, the older andesites and dacites form a small stratovolcano or composite cone. The younger rhyodacite sequence forms domes, thick flows, local ash-flow tuff, and accumulations of nonwelded pyroclastic debris, often coarse. As noted earlier, the flows locally are cut by rhyolite domes that clearly are much younger than the rhyodacite; the domes are near-surface counterparts of the pink granite and rhyolite porphyry intrusions that occur at lower levels in the system.

Hydrothermal alteration

Propylitic alteration is common in roof rocks of the Eocene batholith exposed in the Boulder Mountains and near Norton Peak (fig. 1). The extent of alteration and factors controlling its distribution have not as yet been determined. We speculate that the necessary excess CO_2 was derived from the abundant carbonate-rich sedimentary inclusions present in the roof rocks. According to Frank Federspiel and Peter Gabby, U.S. Bureau of Mines (oral commun., 1986), finely disseminated sulfides occur in some of the metasedimentary roof pendants in the area west of the cauldron.

Zones of propylitic alteration that contain abundant pyrite occur along the fault northeast of Norton Peak and in a broad area east of Baker Creek (fig. 1). Near the center of the latter is an area containing zones of intense silicification and argillic alteration. Alteration east of Baker Creek chiefly affects rhyodacitic lava and intrusive rocks, but a rhyolite dome at the southeast margin of the zone of intense alteration also is altered (D. H. McIntyre, unpub. data). Also present, to the north within the graben, are small, deeply weathered, intensely leached altered zones that probably once contained pyrite (fig. 1). We do not know as yet whether metallic mineral deposits of economic interest might be associated with any of these altered zones.

The area west and northwest of Ketchum provides an unusually good opportunity for study of features associated with the upper part of a granitic batholith. Studies currently under way by the U.S. Geological Survey and Idaho State University should further clarify relations in this area.

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