

basis of the middle Miocene age of the Mount Bennett rhyolite (about 10 Ma; Clemens and Wood, 1993) and the Pliocene age of Lake Idaho, which filled the western SRP graben that formed during uplift of the rhyolites. The occurrence of Lake Idaho sediments within the Mount Bennett Hills, sitting depositionally on rhyolite vitrophyre or older basalts (Vetter, oral commun., 1998), shows that uplift of the Mount Bennett Hills continued into the Pliocene.

### QUATERNARY FAULTING

Recent tectonic activity related to extension of the western SRP graben is demonstrated by fault scarps, with 6 to 30 feet (2 to 9 m) of throw, that crosscut the shield

volcanoes and the basaltic flows associated with them. There are two dominant fault sets: one trends N. 85° W.; the other trends N. 60° W. (parallel to the range-front faults) and appears to truncate against the N. 85° W. set (Figure 3). All faults are vertical or high-angle normal faults that dip steeply to the south and are downthrown on the south or southwest side. Similar relationships are observed in the western Mount Bennett Hills where east-west trending faults offset N. 50° W. faults (Clemens and Wood, 1993).

Both sets of faults appear to have been active simultaneously, as shown by asymmetric escarpments in the N. 85° W. faults that have larger offsets at the east end than at the west end. This asymmetric movement on the N. 85° W. faults was accommodated by movement on the N. 60°

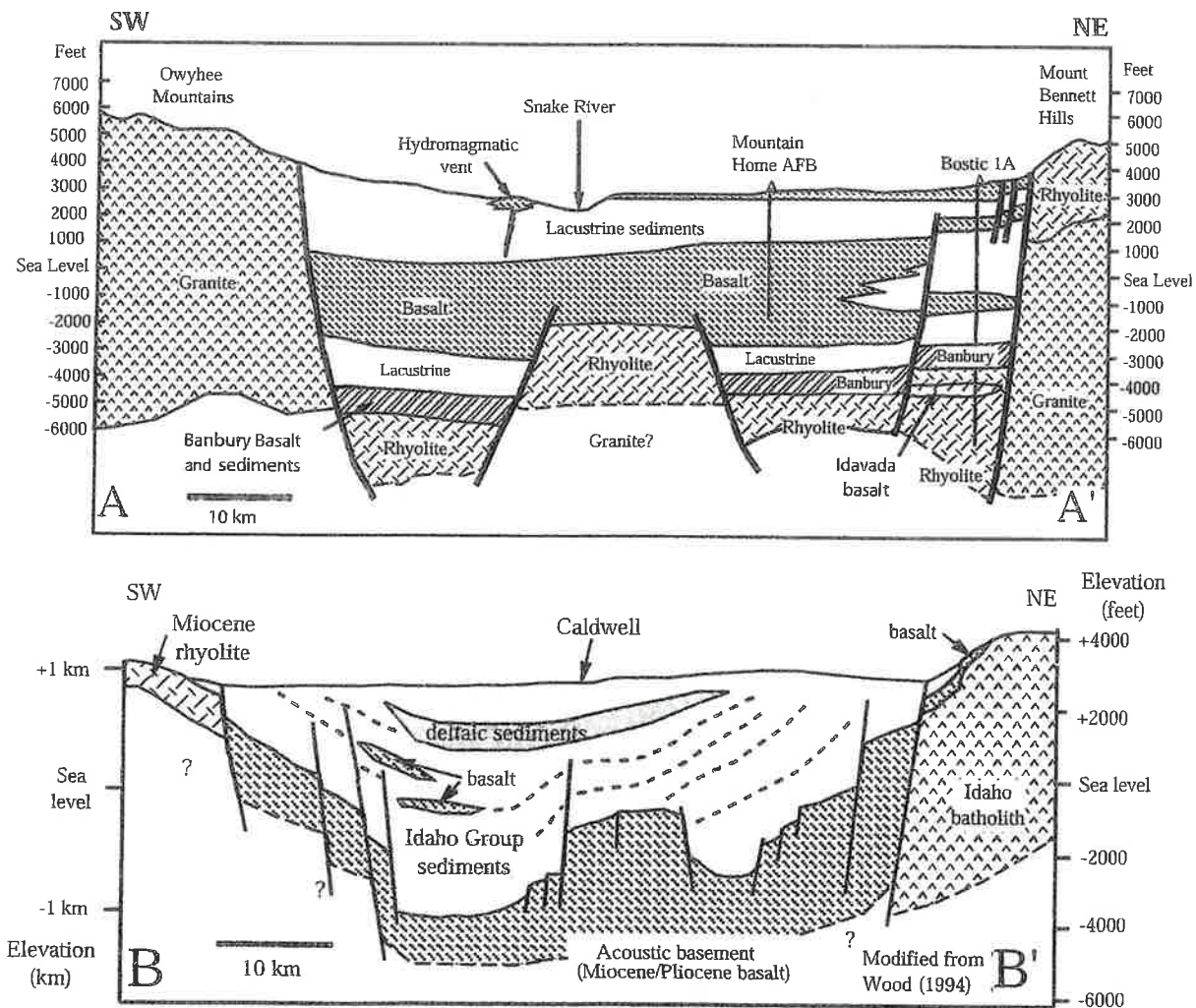


Figure 6. Interpretive cross sections of western SRP: section A-A' from Owyhee Plateau to Mountain Home area; section B-B' through Caldwell (see Figure 2 for location of sections). Section A-A' based on well logs of Mountain Home AFB core (Lewis and Stone, 1988), the Bostic 1A well (Arney and others, 1982, 1984), gravity profiles of the western SRP, and surface mapping (this study; Jenks and others, 1993). Section B-B' near Caldwell, modified from Wood (1994), is based on well logs and seismic reflection data.

Exhibit 105

W. faults, many of which also preserve asymmetric escarpments that have larger offsets on their north ends. The sense of motion here seems to be one in which trapezoid-shaped lozenges of crust accommodated northeast-southwest extension by rotating along pairs of south-dipping and southwest-dipping normal faults.

The age of faulting cannot be determined precisely at this time but must be younger than about 1 Ma, based on the age of the basalt units cut by the faults. In one location, basalt is faulted against alluvial gravel of Canyon Creek (Figure 3), suggesting a late Pleistocene or Holocene age. Beukelman (1997) has shown that similar scarps which offset alluvium in the Halfway Gulch-Little Jacks Creek area south of Mountain Home have ages of about 5,000 to 34,000 years, based on the degradation of scarp profiles. Trenching across one fault indicates five episodes of surface rupture over the last 26,000 years, based on caliche accumulation in the soils (Beukelman, 1997).

## GEOCHEMISTRY

Geochemical studies of the volcanic rocks described here are still in progress, so it is not possible to discuss their chemical and petrologic evolution at this time. We can, however, make a general comparison between the older, pre-Lake Idaho lavas sampled by the Mountain Home AFB core and the surface lava flows (Table 1). We can also compare both of these groups to basaltic lavas from the eastern SRP trend (Shervais and others, 1994) and to flood basalts of the Columbia River Plateau province (Tolan and others, 1989; Reidel and others, 1989; Hooper, 1988).

In general, late Pliocene to Quaternary surface flows in the Mountain Home area are similar to basaltic lavas from the eastern SRP in their Fe, Ti, alkali, and silica content (Figure 7). Fe is at the high end of the range for this trend and is higher than typical eastern SRP basalts in many samples. In contrast, early Pliocene, pre-Lake Idaho basalts from the Mountain Home AFB core are much higher in Fe and Ti and lower in alkalis, silica, and phosphorus than typical basalts of the eastern SRP. This suggests a source for the older basalts that is depleted relative to the eastern SRP basalt source in large ion lithophile elements (LILE), but enriched in Fe and Ti, possibly as a result of Fe-Ti metasomatism (Shervais and Vetter, 1992).

When compared with basalts of the SRP province, flood basalts of the Columbia River Plateau (Tolan and others, 1989; Reidel and others, 1989) are much lower in Mg, Fe, Ti, and P and higher in Si and K (Figure 7). This suggests that, relative to basalts of the SRP province, the

Columbia River basalts have seen much more exchange with continental materials. This may reflect either assimilation of subcontinental lithosphere or partial melting and assimilation of continental crust (Carlson, 1984; Carlson and Hart, 1988; Carlson and others, 1981).

## DISCUSSION

The history of basaltic volcanism in the western SRP is punctuated in the Pliocene by a prolonged hiatus of about 4 million years duration. This is clearly shown by the distribution of basalt and sediment in the Mountain Home AFB core samples, by the stratigraphy of sediments and basalts that crop out in the western SRP, and by seismic profiles of the western SRP (e.g., Wood, 1984, 1994; Wood and Anderson, 1981). The duration of this hiatus corresponds largely with sedimentation in Lake Idaho, but volcanism and sedimentation overlapped in time and space both near the beginning of sedimentation in the early Pliocene and near its end in the late Pleistocene. This overlap is greater farther to the west, near Boise and Caldwell, where phreatomagmatic vents demonstrate the eruption of large volcanos within standing water of the lake (Godchaux and others, 1992). The hiatus in basaltic volcanism shows that development of the western SRP occurred during two separate and possibly unrelated events. We examine each of these events below.

### PRE-LAKE IDAHO TECTONICS AND VOLCANISM

Formation of the western SRP graben was preceded by the eruption of high-temperature rhyolites from northwest-trending fissures (Honjo and others, 1992; Bonnicksen, 1997). These rhyolites have anhydrous phenocryst assemblages and calculated eruption temperatures of around 850°C to 1,000°C (Honjo and others, 1992). Existing radiometric dates suggest an age progression of high-temperature rhyolites from northwest to southeast. Thus, rhyolites at the northwest end of the western SRP have ages around 11.2 Ma to 11.6 Ma; rhyolites in the Danskin Mountains have ages of 10.0 Ma to 11.0 Ma, and rhyolites in the western and central Mount Bennett Hills have ages of 9.2 Ma to 9.8 Ma (Armstrong and others, 1975, 1980; Honjo, 1990; Clemens and Wood, 1993).

Range-front faults in the western SRP are associated with the formation of the western SRP graben, which became the locus of deposition of Lake Idaho in the late Miocene through Pliocene (Figure 6). The formation of this graben predates Basin and Range extension, and its orientation (about N. 50° W.) is inconsistent with other