The geology and geothermal potential of the upper Madison Valley between Wolf Creek and the Missouri Flats, Madison County, Montana
by Gerald Joseph Weinheimer

A thesis submitted in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE in Earth Sciences
Montana State University

Abstract:
The geological evidence suggests that the thermal water circulation within five thermal springs in the study area is controlled by deep cross valley faults at the margins of thickened wedges of valley alluvium in the Missouri Flats and Ennis Basins. This fault system allows ground water recharging into the Madison Range front fault and the many intra-valley faults to circulate to a depth sufficient for thermal heating.

The geothermal potential in the Madison Valley as indicated by field and geochemical investigations shows reservoir temperatures insufficient for power generation. However, Wolf Creek Hot Spring and Wall Canyon Warm Spring appgar to have the hottest reservoir temperatures (about 110°C) and could he used for space heating and agricultural development. Curlew Creek, Sloan Cow Camp, and the West Fork Warm Springs are of low priority since preliminary investigations indicate low reservoir temperatures.

The faults which control thermal water circulation were produced by tensional stress activity in the Missouri Flats and Ennis Basins. These faults displace Pleistocene rhyolite tuff Which overlies alluvium or Precambrian gneiss and is overlain in turn by glacial moraines and outwash. Sanidine from the rhyolite was dated at 1.9 m.y. indicating Huckleberry Ridge age. The tuff can be traced from its source in the Yellowstone Caldera to several km north of Wall Canyon. The extensive flow is useful in mapping the fault pattern developed within the Upper Madison Valley.

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Signature Gerald Joseph Weinheimer

Date May 1979

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by

GERALD JOSEPH WEINHEIMER

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Approved:

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INTRODUCTION

Location

The study area is located in southwestern Montana about 50 km west of Yellowstone National Park and 14 to 28 km north of the Montana-Idaho boundary (Fig. 1).

The area includes the eastern three-fourths of the Cliff Lake 15 minute quadrangle. Extending from 111°30'W to 111°42'W longitude and 44°45' N to 45°00' N latitude, this area includes the Madison Valley from Wolf Creek southward to the Missouri Flats and the West Fork of the Madison drainage. On the east and west boundaries are the Madison and Gravelly Ranges (Fig. 2).

The Madison Valley ranges in elevation from 1770 to 2440 m and has an annual precipitation of between 40 and 80 cm. Its climate is characterized by heavy snows and long cold winters, cool summers with very few frost-free days. The vegetation growing on alluvium, outwash and the flat-lying rhyolite tuff plateaus is sagebrush. In areas of rhyolite tuff talus or glacial moraines, lodgepole pine, spruce, and Douglas fir form the main vegetative cover.

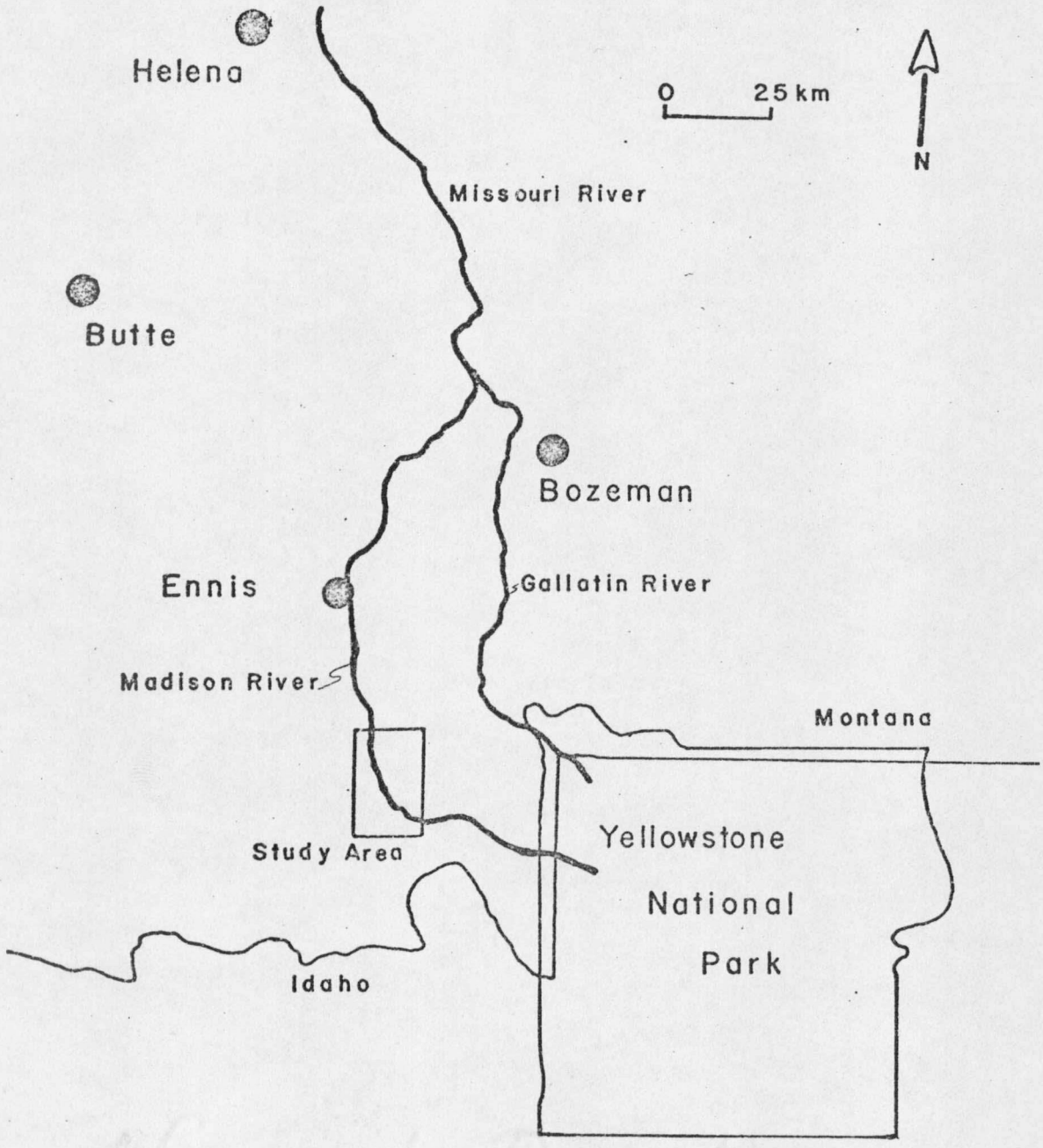

FIGURE 1. Index map.