SURFICIAL GEOLOGIC MAP OF THE

BITTERROOT VALLEY, MONTANA

by

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Correlation of Map Units

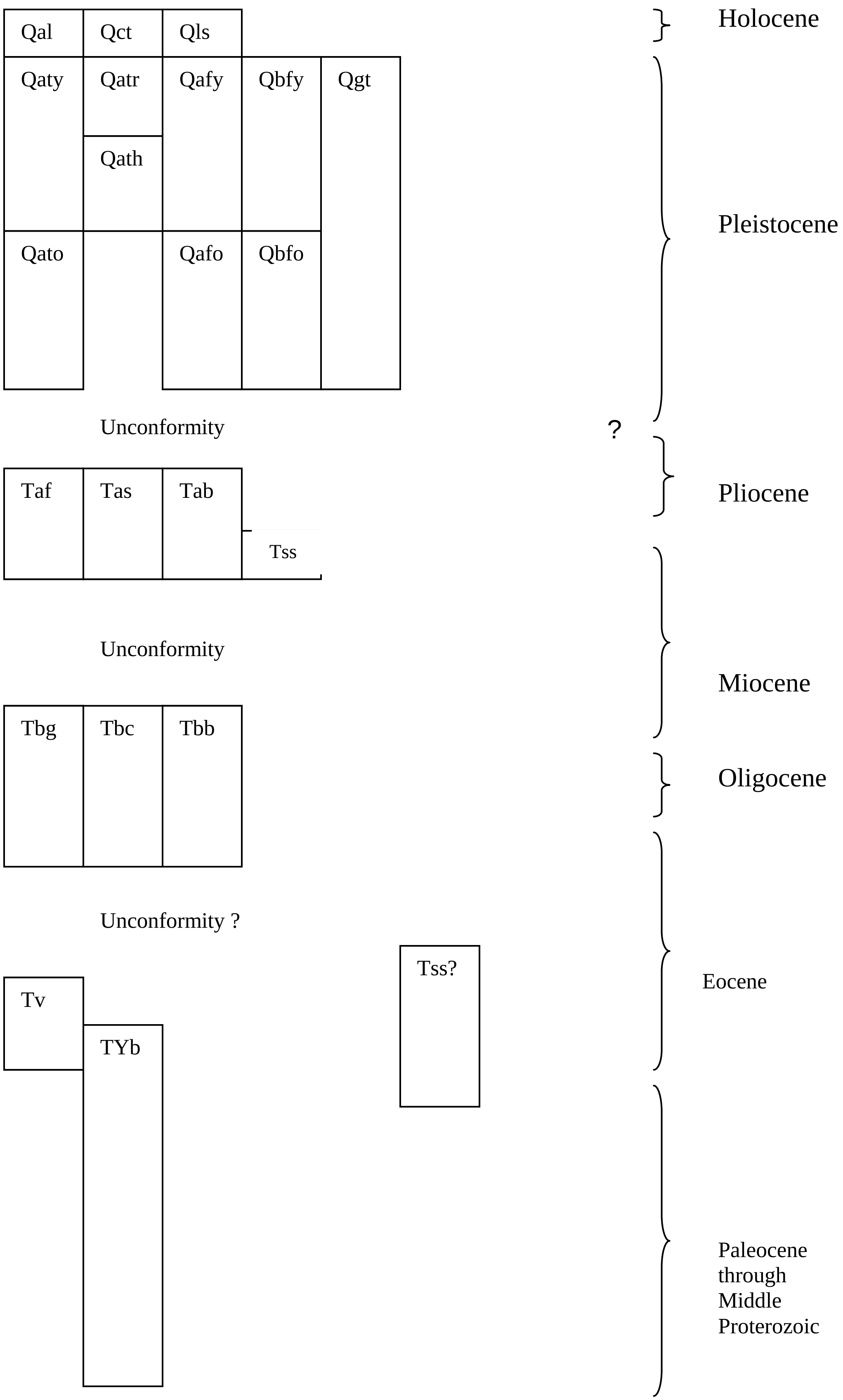

Figure 1. Correlation chart of units shown on geologic map.

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Description of Lithologic Units

Qal ALLUVIAL DEPOSITS OF ACTIVE CHANNELS AND PRESENT FLOOD PLAINS (HOLOCENE)

Well-rounded, well-sorted gravel and sand with a minor amount of silt and clay. Clast lithologies represent rock types of the entire drainage basin, including granitic, volcanic, metamorphic, and sedimentary rocks. Well logs show an average thickness of 40 feet and good water transmission and storage characteristics (McMurtrey and others, 1972). Wells are capable of yielding more than 250 gallons per minute. May have high water tables, detrimental to construction.

Qct COLLUVIAL AND TALUS DEPOSITS (HOLOCENE)

Unconsolidated, unsorted, locally derived accumulations of angular boulders, cobbles, pebbles, sand, and silt on steep slopes.

Qls LANDSLIDE AND EARTHFLOW DEPOSITS (HOLOCENE)

Unsorted and unstratified mixtures of locally derived material transported down adjacent steep slopes. Characterized by irregular hummocky surfaces. Occur mostly as earthflows on slopes underlain by either the blue clay facies (Tbc) of the ancestral Bitterroot River unit or by weathered volcanic rocks (Tv).

Qaty ALLUVIUM OF THE YOUNGER RIVERSIDE AND HAMILTON TERRACES, UNDIVIDED (LATE PLEISTOCENE?)

Well-rounded, well-sorted gravel and sand underlying the youngest terraces in the northern part of the valley, where the Riverside and Hamilton terraces cannot be distinguished. The surfaces of these deposits stand 10 to 20 feet above the present floodplain, and are approximately 10 to 30 feet thick. Predominately granitic, gneissic, and Belt sedimentary clasts, with minor volcanic clasts.

Qatr ALLUVIUM OF THE RIVERSIDE TERRACE (LATE PLEISTOCENE?)

Well-rounded, well-sorted gravel and sand underlying the youngest terrace, termed the Riverside terrace by Weber (1972), along the Bitterroot River. The surfaces of these deposits stand 10 to 15 feet above the present floodplain. Thickness estimated at 10 to 20 feet. Predominantly granitic, gneissic, and Belt sedimentary clasts, with minor volcanic clasts.

Qath ALLUVIUM OF THE HAMILTON TERRACE (LATE PLEISTOCENE?)
Well-rounded, well-sorted gravel and sand underlying the second youngest terrace, the Hamilton terrace (Weber, 1972), along the Bitterroot River. The surfaces of these deposits stand 20 to 25 feet above the present floodplain. Thickness is from 10 to 30 feet. Predominantly granitic, gneissic, and Belt sedimentary clasts, with minor volcanic clasts.

Qafy YOUNGER ALLUVIAL OUTWASH TERRACE AND FAN COMPLEX DEPOSITS (LATE PLEISTOCENE?)
Well-rounded, unweathered cobbles and boulders in a matrix of sand and gravel deposited in braided-stream environments that formed between and below the dissected remnants of older fans. Clasts are mostly representative of the local geology, but are derived from both bedrock and reworked, older unconsolidated deposits. Sorting increases and grain size decreases with distance from the mountain fronts. Surfaces of these deposits stand 5 to 25 feet above the active channels. At least three levels and ages are present (Weber, 1972), but are not distinguishable everywhere. Some fans coalesce with the younger alluvial terrace deposits (Qatr, Qath, and Qaty). Thickness averages 40 feet (McMurtrey and others, 1972); usually a productive aquifer.

Qbfy YOUNGER BOULDER FANS REPRESENTING DEBRIS FLOW DEPOSITS (LATE PLEISTOCENE)
Huge angular boulders as much as 10 feet across set in a poorly sorted matrix of gravel, sand, and silt. Clasts are locally derived. These deposits probably represent a catastrophic flood event of glacial origin.

Qato ALLUVIUM OF THE OLDEST TERRACE (EARLY PLEISTOCENE)
Well-rounded, well-sorted gravel and sand underlying terraces 50 to 60 feet above the level of the present floodplain along the Bitterroot River north of Hamilton. Predominantly granitic, gneissic, Belt sedimentary, and volcanic clasts, and lithologically indistinguishable from the gravel facies of the ancestral Bitterroot River unit (Tbg). Only 10 to 20 feet thick.

Qafo OLDER ALLUVIAL OUTWASH TERRACE AND FAN COMPLEX DEPOSITS (EARLY PLEISTOCENE)
Well-rounded, locally derived cobbles in a matrix of sand and gravel deposited in outwash fan environments. Surfaces of these deposits are now perched above younger alluvial fan deposits (Qafy). This unit covers older deposits in some places, and in other places lies between and topographically below incised remnants of older deposits. The steep profile, undissected nature, and visible braided channel patterns on air photos distinguish Qafo from older fan deposits (Taf). This unit includes deposits of several ages and topographic levels. Some may represent deltaic deposits along the shores of Glacial Lake Missoula.

Qbfo OLDER BOULDER FANS REPRESENTING DEBRIS FLOW DEPOSITS (EARLY PLEISTOCENE)

Huge, angular, locally derived boulders as much as 10 feet across set in a poorly sorted matrix of gravel, sand, and silt. These boulders probably represent catastrophic flood events of glacial origin.

Qgt GLACIAL TILL (PLEISTOCENE)

Unsorted, mostly unstratified clay, silt, sand, and gravel, with boulders as much as 20 feet in diameter. Moraines record at least three stages of glaciation beginning in the early Pleistocene (Weber, 1972). Till yields very little water to wells (McMurtrey and others, 1972).

Taf ALLUVIAL FAN DEPOSITS (PLIOCENE AND LATE MIOCENE)

Brown, unconsolidated to weakly lithified, poorly sorted, moderately stratified subangular to rounded boulders, cobbles, and sandy silt deposited in alluvial fan environments. Unit includes abundant brown, massive, micaceous silt beds. Found as interfluvial remnants perched 200 feet or more above the present Bitterroot floodplain and capping pediments or strath terraces formed on older units. Clasts are locally derived, and are often coated with brown iron oxide or caliche. Bedding typically dips more steeply than the surface of this unit, indicating an erosional surface. Lag deposits of small, subangular boulders are common on these pediment surfaces. This unit is characterized by a gentle surface profile, weathered granitic clasts, oxide- or caliche-coated sedimentary clasts, extensive dissection, lack of braided channel patterns on air photos, and a lower contact at least 200 feet higher than the present Bitterroot River. It is a poor aquifer due to both its drained nature and its low permeability.

Tas ALLUVIAL FAN DEPOSITS DOMINATED BY SILT (PLIOCENE AND LATE MIOCENE)

A brown, silt-dominated facies of Taf, that also contains lenses and channels of poorly sorted subangular cobbles. Otherwise this unit shares the same characteristics of Taf. Usually a poor aquifer.

Tab BOULDER FANS REPRESENTING DEBRIS FLOW DEPOSITS (PLIOCENE AND LATE MIOCENE)

Angular, weathered boulders as much as 10 feet across in a poorly sorted matrix, probably a debris flow facies of Taf. Same characteristics as Taf.

Tss SILT AND SAND (MIOCENE ?)

Predominantly brown, weakly indurated, poorly sorted, poorly stratified, biotite-rich, subangular sand and silt. Also contains brown silty layers with root casts and burrows interpreted to be paleosols. Volcanic ash is abundant both in clay-rich layers and as tephra beds. Lenses of poorly sorted, locally derived, angular cobbles and of well-sorted, cross-laminated, locally derived, fluvial gravel are present. Found beneath Taf, but may be only slightly older and a facies of that unit. Alternatively, it may be a facies of the ancestral Bitterroot River unit (Tbg, Tbc) proximal to the Sapphire Mountains. Fossils indicate a middle to late Miocene age, as with some Tbg and Tbc (Konizeski, 1958). Abundant volcanic ash may also indicate age correlation with Tbg and Tbc.

Tbg FLUVIAL GRAVEL OF THE ANCESTRAL BITTERROOT RIVER CHANNEL, "ABR FACIES" (MIDDLE MIOCENE? THROUGH LATE EOCENE)

Predominantly light-gray to white, unconsolidated, well-sorted, well-rounded, well-stratified, sand, pebbles, and cobbles. Clast lithologies are representative of rocks from the entire drainage basin and include granitic rocks, Bitterroot mylonite, Belt quartzite, Belt carbonate, high-grade metamorphic rocks, extrusive volcanic rocks, and black and red chert. Informally called the "ancestral Bitterroot River (ABR) facies" in this study. Contains as much as 50% interbedded light-tan clay and silt that predominate in the blue clay facies (Tbc) with which this unit interfingers. Fossil assemblages probably collected in the blue clay facies (Tbc) indicate an age of Oligocene to late Miocene (Konizeski, 1958). In equivalent sediments near Missoula, Harris (1997) mapped a 39-million-year-old volcanic ash bed. Tbg hosts most of the developed sand and gravel deposits in the Bitterroot Valley. It is also a productive aquifer, with wells often yielding more than 50 gallons per minute. Deep drill holes show that unconsolidated sedimentary rocks similar to Tbg and Tbc are as much as 2400 feet thick in places (Norbeck, 1980).

Tbc CLAY, SILT, AND TEPHRA OF THE ANCESTRAL BITTERROOT RIVER CHANNEL, "BLUE CLAY FACIES" (MIDDLE MIOCENE? THROUGH LATE EOCENE)

Informally called the "blue clay facies" in this study after well-log descriptions. Mostly light-gray clay and silt in beds 6 inches to 5 feet thick, with abundant interbedded tephra. Contains lenses of well-sorted, cross-stratified fluvial gravel like that described for the ancestral Bitterroot River (ABR) facies (see unit Tbg). Interfingers with the ABR facies (Tbg). Some brown, ledge-forming, massive silty layers with root casts and burrows are present and interpreted to be paleosols. Landslides commonly develop where this unit underlies steep slopes, especially where irrigated. Swelling clays are also common.

Tbb FLUVIAL BOULDER-COBBLE GRAVEL OF THE ANCESTRAL BITTERROOT RIVER CHANNEL (MIDDLE MIOCENE? THROUGH LATE EOCENE)

Poorly exposed, well-rounded, well-sorted sand, cobbles, and boulders of mostly Belt sedimentary rocks. Characterized by abundant boulders of quartzite as much as 2 feet across. This unit forms flat surfaces high on the northwest side of the valley, and always occurs as a thin deposit overlying bedrock. Although it apparently represents deposits of the ancestral Bitterroot River, it may be older than units Tbg and Tbc.

Tv INTRUSIVE AND EXTRUSIVE VOLCANIC ROCKS, UNDIVIDED (EOCENE)

Includes flows, volcaniclastic rocks, tuff, welded tuff, and dikes and sills of mostly rhyolitic composition. Extrusive rocks are mostly gray to yellowish gray porphyritic latite tuff, red to pink rhyodacite vitrophyre, and volcanic breccia containing fragments of porphyritic basalt, rhyodacite, obsidian, and quartz latite. Dikes are mostly thin (less than 100 feet), reddish colored, topographically resistant features containing phenocrysts of quartz, sanidine, plagioclase, biotite, and hornblende in an aphanitic groundmass. Flow banding is common. Small landslides occur in the northeastern part of the valley where Tv is deeply weathered.

TYb BEDROCK, UNDIVIDED (EOCENE THROUGH MIDDLE PROTEROZOIC)

Includes Belt sedimentary rocks, amphibolite-grade metamorphic rocks, and plutonic rocks.

Geologic Map Symbols

Contact

Fault. Sense of movement and dip of fault plane unknown. Dotted where concealed.


Normal fault. Ball and bar on downthrown side. Dotted where concealed.


Lineament visible on air photos. Barkman (1984) interpreted some of these to be fault scarps, but poor exposure has prevented field verification. Cartier (1984) also provided evidence that the Bitterroot Valley is seismically active.

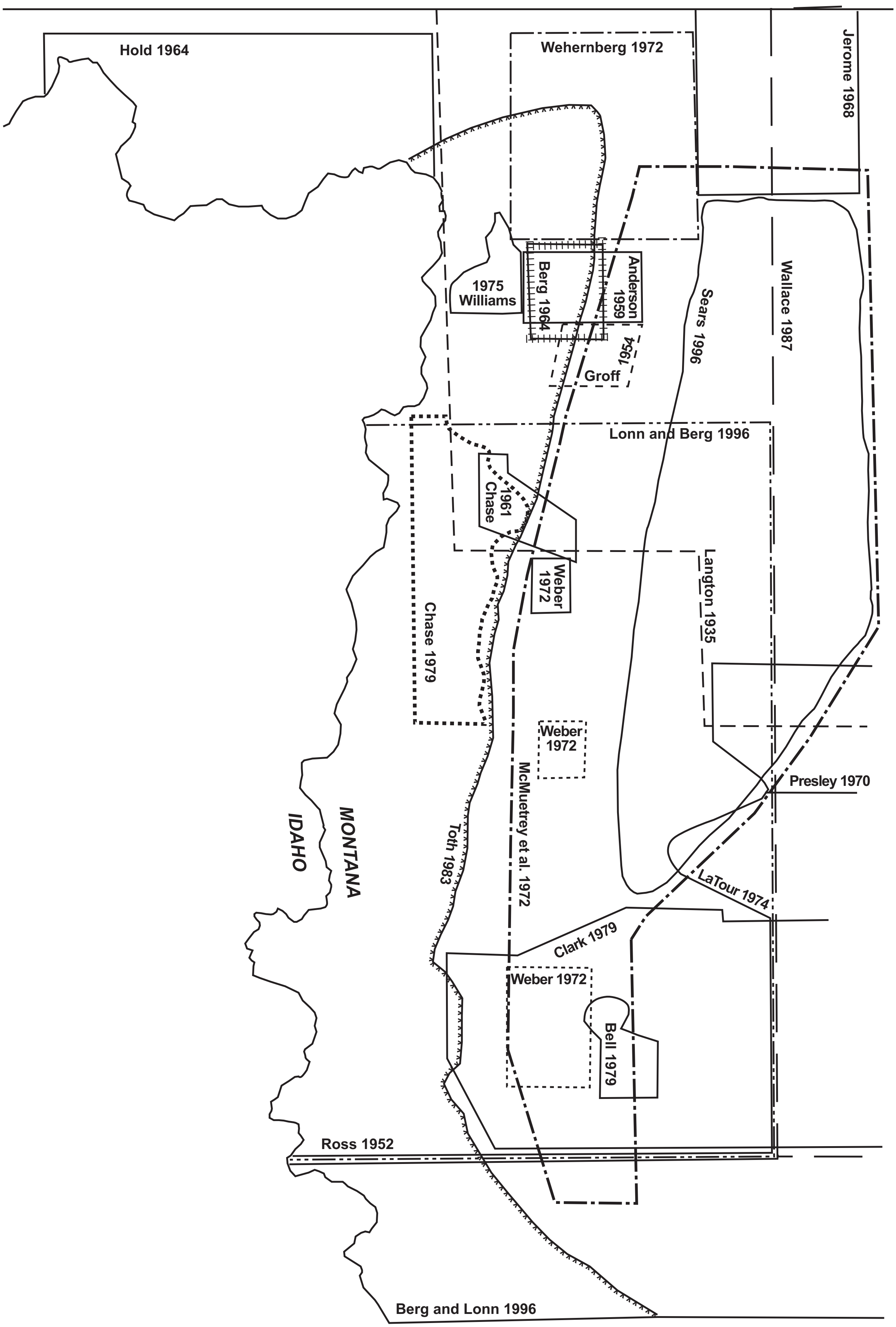

Figure 2. Index to previous geologic mapping in the Bitterroot Valley, Montana (see bibliography of previous mapping).

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(see Figure 2)

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