Golconda Summit, I80. Above highway where trucks are, Cambrian Preble Frm (phyllitic shale) under Antler Peak ls, Penn-Perm reef ls—juxtaposed on Iron Point fault (thrust on old maps, LANF in Cashman et al). Edna Mtn (Permian ss) at very top of hill. Small hill at right has Iron Point Thrust again within it. To left of highway, peak with antennae is Golconda Summit, which is Penn shale+chert of upper plate of Golconda allochthon. Ledge 1/3 way up is Antler Peak ls with brown Edna Mtn Frm above. Most of gray slopes behind is greenstone unit (basalts-andesites of Penn age) of upper plate of Golconda.
Craford notes lower plate pretty undeformed, but upper plate hammered—in places relatively undeformed Tr on top. Also discuss Nolan belt, which is defined by Craford as having continental affinity but higher grade metamorphism and west-verging thrusting in pre-mid-Penn...
sandstone interbeds. The Trenton unit is composed mainly of chert and shale. In other exposures of the Havallah sequence, the uppermost unit is the Mill Canyon Member, which includes interbedded turbidites, chert, and shale (Miller et al., 1982). Sandstones from the Middle Pennsylvanian–Lower Permian Jory unit and the Lower Permian Pumpernickel unit were analyzed during this study (Fig. 4).

In general, the monotonous lithology and structural complexity of the Havallah and Schoonover sequences preclude a full understanding of the structure of the Golconda allochthon. Both units are multiply deformed in most exposures, and structures include boudins, mullions, and open to tight folds. During progressive deformation of the Golconda allochthon, bedding was disrupted and thrust faults imbricated all rock types. According to a number of workers (e.g., Miller et al., 1982; Snyder and Brueckner, 1983; Babaie, 1987), a significant amount of the deformation occurred prior to emplacement of the allochthon onto the continental margin, as the subjacent autochthon is not as pervasively deformed as the Golconda allochthon.

A first-order problem in Cordilleran tectonics concerns the pre-emplacement position of the Golconda allochthon with respect to nearby terranes as well as North America. One model suggests that strata of the Golconda allochthon were deposited in a relatively wide basin and were subsequently incorporated into an accretionary prism built along the inboard margin of a magmatic arc that faced eastward, or toward the North American continent (Speed, 1979; Schweickert and Snyder, 1981; Speed and Sleep, 1982; Snyder and Brueckner, 1983; Dickinson et al., 1983; Brueckner and Snyder, 1985; Babaie, 1987). An opposing view asserts that the strata were deposited within a relatively narrow basin separating the North American margin from an outboard, west-facing magmatic arc (Burchfiel and Davis, 1972, 1975; Silberling, 1973; Miller et al., 1984, 1992; Harwood and Murchey, 1990; Burchfiel and Royden, 1991; Burchfiel et al., 1992). In addition, the possibility exists that strata within the allochthon accumulated a great distance from their present position and are far traveled (Coney et al., 1980).
Mountain Quartzite ([Yreka terrane]) may have been derived directly from basement rocks exposed along the continental margin, whereas more mature quartz sands were probably recycled from miogeoclinal and/or platformal strata in the Peace River arch region.

Ordovician strata of the Roberts Mountains allochthon also contain 1.8–1.4 Ga grains that originated in basement rocks of the southwestern United States (provenance link 3). As concluded by Finney and Perry (1991) on the basis of biostratigraphic and facies relations, there is a strong link between lower Middle Ordovician rocks of the Vinini Formation and coeval strata of the miogeocline directly to the east. Derivation of sediment from nearby continental sources apparently resulted from a low sea-level stand, during which sand was eroded from either exposed basement rocks or their platformal cover and transported across the miogeocline via channels carved into the continental shelf (Finney and Perry, 1991).

Units in the Roberts Mountains allochthon and Shoo Fly Complex also contain detrital zircons of 1.0–1.3 and ca. 0.7 Ga, which were most likely shed from basement rocks exposed along the southern continental margin (Wallin, 1990a) (provenance links 1 and 6). The dominant source may have been a westward continuation of 1.0–1.3 Ga rocks of the Grenville province, perhaps now preserved in the Oaxaca terrane of Mexico (Coney and Campa, 1987; Ruiz et al., 1988). The 0.7 Ga grains in the Harmony Formation were originally reported to have an uncertain provenance (Wallin, 1990a; Smith and Gehrels, 1994), but the unique occurrence of a 0.7 Ga grain in 140 G.E. Gehrels et al.
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with the craton margin to the east. Because of this possibility, the >1.77 Ga Mississippian through Permian strata yield detrital zircon ages were derived from outboard rocks of the Shoo Fly Complex in southwestern United States. If this is the case, how-ever, the lack of ca. 1.43 Ga grains in our samples is puzzling. Nickel and a ca. 1713 Ma grain in Schoonover Q, which are consistent with either source or a combination of the two sources. However, it is also possible that the older grains were recycled from lower Paleozoic rocks of the Roberts Mountains. The only grains that may have a unique source are ca. 1713–1731 Ma grains. These grains were most likely derived from the Roberts Mountains allochthon than the northern Sierra terrane. In addition, it is possible that these grains were derived from a magmatic arc that has an uncertain provenance (Wallin, 1990a; Smith and Royden, 1991; Burchfiel et al., 1992).

While all of these scenarios remain viable, model 2 is pre-ferred. In this model, the craton margin gradually moved to the east over time. As it moved, the middle to late Paleozoic arc was transported inboard, and the arc was accreted at the margin of the craton. Some detritus would have been recycled from the Shoo Fly Complex, exposed to the west, within the allochthon (Fig. 4), which were described by Miller et al. (1991). As the craton margin moved further to the east, the arc was recycled from lower Paleozoic rocks of the Roberts Mountains magmatic arc, now preserved as the northern Sierra and eastern Klamath terranes. In addition, it is possible that these grains were derived from a magmatic arc that has an uncertain provenance (Wallin, 1990a; Smith and Royden, 1991; Burchfiel et al., 1992).

Most detritus would have been related to subduction and/or the Roberts Mountains allochthon, exposed in the Antler orogen from the Golconda allochthon prior to the Sonoma orogeny (Speed and Sleep, 1982; Dickinson et al., 1983). Antler overlap curve summarizes 63 analyses from three samples and degree of similarity evaluates degree to which overlapping ages have perfect overlap and proportions, respectively, of two age spectra. Most detritus would have been recycled from the Shoo Fly Complex, which is currently exposed basement rocks or their platformal cover and transported to the west. It is possible that these grains were derived from a magmatic arc that has an uncertain provenance (Wallin, 1990a; Smith and Royden, 1991; Burchfiel et al., 1992).

Because of the uncertainties outlined here, at least three potential source regions. Our data also allow for other potential sources, given the widespread extent of mid-Paleozoic igneous magmatism during this time interval (Burchfiel and Davis, 1972, 1980). Figure 7. Results of statistical comparisons of detrital zircon ages from Antler overlap curve summarizes 63 analyses from three samples and degree of similarity evaluates degree to which overlapping ages have perfect overlap and proportions, respectively, of two age spectra.
Note lots of volcaniclastics as well as plutonic rocks
What is the relationship of the Golconda rocks to North America? Back to detrital zircons [which are only a small part of sediment volume]
Original interpretation in 2000 is that all the terranes were connected
Worth recalling how the use of the LA–ICPMS measurements changed the interpretation of Gehrels’s group. Note the Lower Vinini still has more of a southern Laurentian look—except for those 500 Ma ages, which Linde et al. attribute to materials now found as inliers in Idaho batholith and Challis volcanics areas.
Figure 6. Schematic maps of western North America showing interpreted provenance links and paleogeography for Cordilleran margin during early Paleozoic time. Cratonal provinces and miogeoclinal strata are as shown in Figure 1. Darker gray pattern represents proposed distribution of off-shelf assemblages such as Roberts Mountains allochthon, whereas horizontal ruled pattern outboard of miogeoclinal represents convergent margin assemblages such as Yreka terrane. The inverted V pattern represents possible trace of a magmatic arc outboard of Cordilleran margin. West-facing arc may have existed along margin during much or all of early Paleozoic time, or east-facing arc may have approached the margin during Devonian time. Black arrows represent interpreted dispersal patterns of sand in offshore settings, with numbers that are keyed to provenance links listed in Table 1. Gray arrows reflect general transport of sand that accumulated within miogeoclinal strata (Gehrels, this volume). Provenance of detritus in Kootenay terrane is from Smith and Gehrels (1991). Provenance of detritus in eugeoclinal strata of Mexico is from Gehrels and Stewart (1998). PRA—Peace River arch, TCA—Trans-continental arch, KT—Kootenay terrane, BRT—Black Rock terrane, TT—Trinity terrane, YT—Yreka terrane, RMA—Roberts Mountains allochthon, NST—northern Sierra terrane.

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Early Ordovician time. The lower Vinini Formation is derived from the Peace River Arch. A Scotia-style arc has moved to the western margin of northern Laurentia, and a sinistral transpressional fault system has developed along the western margin. RMA strata are tectonically transported south along the margin by this fault system. (E) Late Devonian time. Subduction has initiated along much of the western margin of Laurentia, moving the RMA strata onto the craton. (F) Early Mississippian time. The Elder Sandstone is shed from the Peace River Arch region. (B) Middle Ordovician time. The upper Vinini and Valmy formations are shed from the Peace River Arch into an oceanic basin. The Eureka Quartzite is also derived from the Peace River Arch and transported via longshore current along the western Laurentian margin. (C) Late Silurian time. The Elder Sandstone is derived from the central craton and Transcontinental Arch; the Valmy Formation is derived from the Peace River Arch. (B) Middle Ordovician time. The upper Vinini and Valmy formations are shed from the Peace River Arch into an oceanic basin. The Eureka Quartzite is also derived from the Peace River Arch and transported via longshore current along the western Laurentian margin. (C) Late Silurian time. The Elder Sandstone is derived from the central craton and Transcontinental Arch; the Valmy Formation is derived from the Peace River Arch.
Beginning in Devonian time, the lower Paleozoic assemblages described here were variably deformed and metamorphosed. Strata of the Roberts Mountains allochthon were transported south along the margin by this fault system. (E) Late Devonian time. Subduction has initiated along much of the western margin of Laurentia, moving the RMA strata onto the craton. (F) Early Mississippian time. The Eureka Quartzite is also derived from the Peace River Arch and transported via longshore current along the western Laurentian margin. (C) Late Silurian time. The Elder Sandstone is shed from the Peace River Arch region. (D) Middle Ordovician time. The upper Vinini and Valmy formations are shed from the Peace River Arch into an oceanic position of the paleoequator. Blue wavy lines show approximate depositional pathways of units discussed. Transcontinental Arch (Sloss, 1988) and Peace River Arch (Ross, 1991) are superimposed. (A) Early Ordovician time. The lower Vinini shelf facies strata for a distance of ~200 km (Roberts et al., 1958; Dickinson et al., 1983). Miogeoclinal units to the west of the Roberts Mountains allochthon are overlain by Carlsbad Group volcanogenic rocks similar to those in the Sierra-Klamath terranes, but with less abundant volcanic strata (Wyld, 1990).
Figure 9. Schematic map of western North America showing our preferred paleogeography for Cordilleran margin during late Paleozoic time. Cratonal provinces and miogeoclinal strata are as shown in Figure 1. Horizontal ruled region represents arc-type terranes such as eastern Klamath terrane. Vertical ruled region represents basinal assemblages such as Golconda allochthon, that formed in backarc basin setting. Small arrowed patterns represent extensional, east-facing arc active during emplacement of Roberts Mountains allochthon (following Burchfiel and Royden, 1991). Large arrowed V pattern represents west-facing magmatic arc that is interpreted to have been active after Antler orogeny. Small black arrows show inferred directions of crustal extension within this arc system. KT-Kootenay terrane, BRT-Black Rock terrane, GA-Golconda allochthon, EKT-eastern Klamath terrane, RMA- Roberts Mountains allochthon, NST-northern Sierra terrane. Large gray arrows reflect the general transport of sand that accumulated within miogeoclinal strata (Gehrels, Introduction).

Figure 12. Schematic map of western North America showing our preferred paleogeography for Cordilleran margin during Triassic time. Cratonal provinces and miogeoclinal strata are as shown in Figure 1. Horizontal ruled region represents arc-type terranes such as eastern Klamath terrane. Vertical ruled region represents basinal assemblages central Nevada that formed in backarc basin setting. Inverted V path represents trace of west-facing magmatic arc outboard of Cordilleran margin. Small black arrows show inferred direction of crustal extension behind this arc system. Larger gray arrows reflect the general transport of sand that accumulated within miogeoclinal strata (Gehrels, this volume, Introduction). KT-Kootenay terrane, BRT-Black Rock terrane, TT-Tertiary terrane, YT-Yerka terrane, GA-Golconda allochthon, EKT-eastern Klamath terrane, RMA- Roberts Mountains allochthon, NST-northern Sierra terrane, TA-Triassic assemblages.
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Fig. 1. Palaeozoic to early Mesozoic terranes of the North American Cordillera. Terranes are grouped according to faunal affinity and/or source region in early Palaeozoic time. Terrane and geological abbreviations: KB, Kilbuck; QN, Quesnellia; RT, Richardson trough; SM, Slide Mountain; ST, Stikinia; YSB, Yukon Stable Block; YT, Yukon–Tanana terrane in the Coast Mountains; WR, Wrangellia. Inset shows location of the Cordilleran orogen in western North America with respect to Chukotka and Wrangel Island (WI), Pearya in the Arctic Islands, the Greenland Caledonides (Cal.) and the Appalachians along the east coast.
We need to start looking farther afield to see how to connect things up.
is the Permian McCloud Limestone, which contains the defining fusulinid genera of the McCloud faunal belt, described by Miller (1988) as the dispersed remnants of a northeastern Pacific fringing arc. Differences between the McCloud and western Laurentian faunas suggest that in Early to mid-Permian time, the various elements of this belt probably lay 2000–3000 km west of the continental margin and at somewhat more southerly latitudes than at present (Belasky et al. 2002). The peri-Laurentian terranes of western Canada (Stikinia, Quesnellia and Yukon–Tanana) also contain faunas of McCloud affinity (Stevens & Rycerski 1989; Stevens 1995; Nelson et al. 2006). In the Early Permian reconstruction of Belasky et al. (2002), the Eastern Klamath terrane lay south of Stikinia–Quesnellia, and somewhat south of its present location. Therefore, if the Eastern Klamath terrane was already interacting with distal parts of northwestern Laurentia in Early Devonian time, it had travelled over 3000 km southwards by the Permian. This would require sinistral motion with respect to western Laurentia that averaged slightly more than 2 cm a\(^{-2}\) for 130 Ma.

Northern Sierras - Golconda allochthon

![Schematic cross-section of the Northern Sierra terrane and Golconda allochthon](image)

Colpron and Nelson, Geol Soc Lond Spec Pub 318, 2009
Colprin and Nelson connect alloclaths in lower Shoo Fly with northern BC based on the older TIMS detrital zircon work. Here we compare with newer stuff, and maybe OK. Lang–Duncan Peak–Culbertson
Colprin and Nelson connect allochthons in lower Shoo Fly with northern BC based on the older TIMS detrital zircon work. Here we compare with newer stuff, and maybe OK. Lang–Duncan Peak–Culbertson
Significance of Sonoman orogen: Seems to reflect the collapse of some marginal oceanic belt between Sierran–Klamath arc to west and Roberts Mtn stuff to east. But there seem to be issues at the early end of the spectrum...