Stratigraphic trends in detrital zircon geochronology of upper Neoproterozoic and Cambrian strata, Osgood Mountains, Nevada, and elsewhere in the Cordilleran miogeocline: Evidence for early Cambrian uplift of the Transcontinental Arch

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ABSTRACT

U-Pb detrital zircon geochronology provides insight into the provenance of the upper Neoproterozoic–lower Cambrian Osgood Mountain Quartzite and the upper Cambrian–lower Ordovician Preble Formation in the Osgood Mountains of northern Nevada (USA). We analyzed 535 detrital zircon grains from six samples of quartz arenite using by laser ablation–multicollector–inductively coupled plasma–mass spectrometry. The detrital zircon age data of these Neoproterozoic–lower Paleozoic passive margin units record a provenance change within the Osgood Mountain Quartzite. Comparison of these data with the work of others reveals that this change in provenance occurred in correlative strata throughout an east-west transect of the Great Basin. From latest Neoproterozoic through earliest Cambrian time, most grains were shed from the 1.0–1.2 Ga Grenville orogen. After that time, drainage patterns changed and most grains were derived from the 1.6–1.8 Ga Yavapai and Mazatzal provinces; very few grains from the Grenville orogen were found in the younger strata. We suggest that this shift records the uplift, in early Cambrian time, of the Transcontinental Arch. Our data also support our interpretation that the Osgood Mountain Quartzite and the Preble Formation are correlative to other contemporaneous passive margin strata in western Laurentia.

INTRODUCTION

The Transcontinental Arch, a region of uplift that extends from the southwestern U.S. to south-central Ontario, Canada (Fig. 1), is a fundamental feature of the lower Paleozoic Laurentian craton. It was first recognized from broad structures and Phanerozoic sedimentation patterns in the mid-continent (Fig. 1) (Keith, 1928). Sloss (1963, 1988) noted the deposition of the middle and lowermost upper Cambrian Sauk II sequence onlapping from the craton margin onto the Transcontinental Arch (Fig. 1). Carlson (1999) proposed, instead of a discrete arch, a platform, a discontinuous zone with highs and lows and flanking basins that give the appearance of an arch (Fig. 1).

In recent U-Pb detrital zircon geochronology studies, researchers have proposed the Transcontinental Arch as a barrier to sediment delivery from the central Laurentian craton to its western margin in early Paleozoic time (Amato and Mack, 2012; Gehrels and Pecha, 2014; Yonkee et al., 2014). Amato and Mack (2012) documented evidence from the Bliss Sandstone for the existence of the Transcontinental Arch by at least the late Cambrian; they explained the differences in detrital zircon populations between the Tapeats Sandstone west of the arch and the Cambrian sandstones east of the arch by the uplift of the arch possibly as early as early Cambrian time. Gehrels and Pecha (2014) estimated the uplift of the arch by early Cambrian time. Others have noted the possibility of early Cambrian uplift of the arch as the cause of the differences in detrital zircon age peaks and groups in passive margin strata in Utah (Yonkee et al., 2014).

Upper Neoproterozoic–lower Cambrian siliciclastic rocks on the western Laurentian passive margin record sedimentation that initiated after rifting and continental separation (e.g., Stewart, 1972; Poole et al., 1992). These passive margin rocks were deposited on a discontinuously exposed succession of diamictite and volcanic strata that reflect initial rifting (e.g., Poole et al., 1992; Yonkee et al., 2014, and references therein). These strata are mostly quartzite, with some siltstone, argillite, and phyllite; carbonate intervals are present in some locations (e.g., Stewart, 1991; Poole et al., 1992). These units have been correlated across a broad region of western North America (e.g., Poole et al., 1992).

Previous detrital zircon studies of upper Neoproterozoic–lower Paleozoic passive margin strata record similar changes in detrital zircon age peaks and groups and therefore possibly similar changes in provenance. Zircon ages in upper Neoproterozoic–lower Cambrian strata in Utah (Lawton et al., 2010; Gehrels and Pecha, 2014; Yonkee et al., 2014), Idaho (Yonkee et al., 2014), and Nevada (Gehrels and Pecha, 2014; Yonkee et al., 2014) change from predominantly Mesoproterozoic in the older strata to upper Mesoproterozoic–Paleoproterozoic in the younger strata.

The only previous detrital zircon study of the Osgood Mountain Quartzite was that of Gehrels and Dickinson (1995), who sampled from the upper part of the formation. The Preble Formation has never been the subject of a published detrital zircon study.

We dated detrital zircons from three localities of the upper Neoproterozoic–lower Cambrian Osgood Mountain Quartzite and the upper Cambrian–lower Ordovician Preble Formation in the Osgood Mountains and near Edna Mountain, north-central Nevada (Fig. 2B; Table 1). We show that the detrital zircon ages shift within the Osgood Mountain Quartzite; detrital zircons from the older samples are predominantly Mesoproterozoic, while detrital zircons from the younger sample, and all of the Preble Formation samples, are predominantly upper Mesoproterozoic–Paleo-
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proterozoic. Coeval passive margin strata in other studies throughout the Great Basin (e.g., Lawton et al., 2010; Gehrels and Pecha, 2014; Yonkee et al., 2014) show the same shift in ages. This suggests that a change in provenance in these passive margin strata is widely recorded in this region of western Laurentia.

In this paper we present new U-Pb zircon ages from the Osgood Mountain Quartzite and the Preble Formation. The dates were obtained using laser ablation-multicollector–inductively coupled plasma–mass spectrometry (LA-MC-ICP-MS). We compare these new data with the detrital zircon ages of coeval passive margin strata throughout the Great Basin to evaluate provenance and sediment transport patterns, and the possibility that these patterns were altered by the uplift of the Transcontinental Arch.

Several unsolved problems are addressed in this study. (1) What is the provenance of the Osgood Mountain Quartzite and the Preble Formation? (2) Are the Osgood Mountain Quartzite and Preble Formation passive margin units, as others have interpreted? (3) Within the Osgood Mountain Quartzite, there is a significant change in detrital zircon grain ages. Are there similar patterns of detrital zircon grain ages varying with time among other coeval passive margin units? (4) If a consistent stratigraphic pattern of detrital zircon ages exists in all Proterozoic–Cambrian sections, what caused a widespread change in detrital zircon ages with time in these units?

**GEOLOGIC SETTING**

The North American craton contains several Proterozoic and Archean age provinces, thus providing geographically distinguishable crustal provinces that are source terranes for the upper Proterozoic and lower Paleozoic continental margin sedimentary section (e.g., Gehrels et al., 2011, and references cited therein) (Fig. 1). The Yavapai-Mazatzal province (1.8–1.6 Ga) forms the core of the craton in the U.S. (Fig. 1). It is bound on the northwest by the Trans-Hudson orogenic terrane (2.0–1.8 Ga) and Archean rocks (older than 2.5 Ga) of the Wyoming and Superior provinces (Fig. 1). It is bound on the east and southeast by the terranes of the Grenville orogen (1.2–1.0 Ga) (Fig. 1).

The 1.2–1.0 Ga Grenville orogen of southern and eastern North America (Fig. 1) was the dominant sediment source for western Laurentia throughout the Neoproterozoic (Rainbird et al., 1997, 2012), including the upper Proterozoic passive margin section from the northwest U.S. to Sonora, Mexico (e.g., Lawton et al., 2010; Gehrels and Pecha, 2014; Yonkee et al., 2014).

In contrast, the 1.8–1.6 Ga Yavapai-Mazatzal and 1.48–1.34 Ga mid-continent granite rhyolite provinces within the North America craton (Fig. 1) were the dominant sediment sources higher in the passive margin section (e.g., Lawton et al., 2010; Gehrels and Pecha, 2014; Yonkee et al., 2014).

The Osgood Mountain Quartzite and Preble Formation in northern Nevada have been interpreted as passive margin strata; they both have an interesting position and tectonic and metamorphic histories. They are far to the west of most other passive margin units and are overthrusted by both the Roberts Mountains allochthon and the Golconda allochthon (Burchfiel et al., 1992; Poole et al., 1992). The Preble Formation is metamorphosed to greenschist facies, and has refolded folds (Cashman et al., 2011); it has been interpreted as being in conformable stratigraphic succession with the Osgood Mountain Quartzite (Fig. 3), based on map relationships and compositional similarity of an upper member of the Osgood Mountain Quartzite to the Preble Formation (Hotz and Wilden, 1964).

Structurally, the Osgood Mountains comprise a large, northeast-trending anticline with a sub-horizontal axis (Fig. 2B). The Preble Formation is exposed only on the flanks of the anticline (Fig. 2B). Late Paleozoic rocks are thrust over the anticline in the northern and western parts of the range, and the southern extent of the Osgood Mountains is overlain by Cenozoic andesite flows (Fig. 2B) (Hotz and Wilden, 1964). The Osgood Mountain Quartzite and Preble Formation are primarily exposed in the central and southern portions of the range (Fig. 2B).

The Osgood Mountain Quartzite consists mostly of fine- to medium-grained quartz arenite, with some silty and sandy beds (Fig. 3). The formation crops out in the Osgood Mountains in a belt 14 km long, from the northwestern Osgood Mountains near Goughs Canyon, to the Golconda Mine area in the northeastern part of Edna Mountain (Fig. 2B). Goughs Canyon and the Golconda Mine, where two samples were taken, are on opposite flanks of an anticline and are relatively high in the stratigraphic section (Figs. 2B and 3). Soldier Pass, where a third sample was collected, is closer to the core of the anticline and is thus lower in the stratigraphic section (Figs. 2B and 3). The base of the Osgood Mountain Quartzite is not exposed; the thickness has been estimated as >1524 m (Hotz and Wilden, 1964). The upper part of the Osgood Mountain Quartzite is the Twin Canyon Member, which crops out only
on the east side of the range, and consists of more silty and shaly material than the rest of the formation. This member has been interpreted as a transition between the Osgood Mountain Quartzite and the overlying Preble Formation (Hotz and Willden, 1964). The Osgood Mountain Quartzite has no fossils (Hotz and Willden, 1964). Based on the age of the overlying Preble Formation, the Osgood Mountain Quartzite is late Neoproterozoic to early Cambrian in age (Madden-McGuire, 1991).

The Preble Formation consists of phyllite and shale, interbedded limestone, and quartz arenite; it crops out over an area ~50 km in length, from northwestern Osgood Mountain near Goughs Canyon south to the Sonoma Range. Ferguson et al. (1952) estimated the thickness of the Preble Formation as ~2350 m based upon the estimated thicknesses of the subunits, although they suggested that the structural thickness may exceed 4572 m due to isoclinal folding. The thickness was estimated by Hotz and Willden (1964) as ~1524 m near Hogshead Canyon (Fig. 2B), where both upper and lower contacts are faults;
however, they noted that tight folding and lack of distinctive bedding precluded them from making detailed studies of the thickness and stratigraphy of the unit. Based on middle-early Cambrian trilobite fauna collected in the lower part of the Preble Formation, the base of the unit is early Cambrian in age (Madden-McGuire, 1991). The fossils occur ~400 m above the upper contact of the pure quartz arenite Osgood Mountain Quartzite, consistent with a late Neoproterozoic age for most of the Osgood Mountain Quartzite (Madden-McGuire, 1991). Graptolites near the youngest subunit of the Preble Formation indicate that the top of the unit is Early Ordovician (Madden-McGuire, 1991).

METHODS

Quartz arenite samples were collected from six locations and stratigraphic intervals (Figs. 2B and 3; Table 1). Three samples were analyzed from the upper Neoproterozoic–lower Cambrian Osgood Mountain Quartzite and three samples were analyzed from the lower Cambrian–lower Ordovician Preble Formation.

Zircon grains were separated and analyzed at the University of Arizona LaserChron facility using standard techniques described by Gehrels (2000, 2012), Gehrels et al. (2006, 2008), and Johnston et al. (2009), to yield a best age distribution reflective of the true distribution of detrital zircon ages in each sample. A split of zircons representative of the final sample yield was mounted in a 2.54-cm-diameter epoxy plug, with the laboratory’s SL (Sri Lanka) zircon standard (563.5 ± 3.2 Ma; Gehrels et al., 2008). Approximately 100 randomly selected grains were analyzed for each sample. Analyses were conducted by LA-MC-ICP-MS using the New Wave UP193HE laser connected to the Nu Plasma high-resolution ICP-MS.

Analytical results are displayed graphically on normalized probability plots (Figs. 4 and 5). We did not include analyses with >10% uncertainty in age, and discarded analyses with >30% discordance (70% concordance) and >5% reverse discordance (105% concordance). Normalized probability plots (Fig. 5) allow visual comparison between zircon populations and display the data from this study and the research of others. The normalized probability plots are generated by summing the ages and uncertainties and normalizing the graphs so that all curves on the same plot have the same area under the curve.

We compared detrital zircon age distributions both visually and statistically. Our initial appraisal was visual comparison of the probability plots. We also compared many age distributions using the Kolmogorov-Smirnov (K-S) statistic (Guynn and Gehrels, 2006). The K-S statistic estimates the probability (P value) that two sample populations could have been derived from the same parent population. P > 0.05 indicates >95% probability that two U-Pb distributions are not statistically different and could have been derived from the same parent (P = 1.0 reflects effective statistical identity). The K-S statistic is sensitive to proportions of ages present, and a low P value may indicate that the proportions of ages are different, even though the ages are similar (Gehrels, 2012).

DETritAL ZIRCON GEOCHRONOLOGY RESULTS

Osgood Mountain Quartzite (Upper Neoproterozoic–Lower Cambrian)

Two samples from near the top of the Osgood Mountain Quartzite, collected at Goughs Canyon and Golconda Mine (Figs. 2B and 3; Table 1), and one sample from ~400 m below the top of the unit, collected at Soldier Pass (Figs. 2B and 3; Table 1), were analyzed. U-Pb data and location information for each sample analyzed in this study is provided in the Supplemental Table1. Our visual and statistical analyses indicate that the Mesoproterozoic and Paleoproterozoic detrital zircon age groups of the two younger samples are similar, although the proportions of ages are somewhat different (see Appendix 1 for a discussion of statistical analysis). The detrital zircon age groups from these two samples are quite different; the older sample is dominated by Mesoproterozoic zircons, while the younger sample is dominated by Paleoproterozoic grains (Fig. 4). K-S test results confirm that these detrital zircon grain populations are dissimilar: P is <0.05.

TABLE 1. LOCATIONS AND NUMBERS OF SAMPLES REFERENCED TO UTM LOCATIONS

<table>
<thead>
<tr>
<th>Sample Location</th>
<th>Easting</th>
<th>Northing</th>
</tr>
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<tbody>
<tr>
<td>Golconda Mine</td>
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</tr>
<tr>
<td>Garden Spring</td>
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<td>4548660</td>
</tr>
<tr>
<td>Goughs Canyon</td>
<td>0488513</td>
<td>4554059</td>
</tr>
<tr>
<td>Soldier Pass</td>
<td>0463570</td>
<td>4548029</td>
</tr>
</tbody>
</table>


Figure 3. Stratigraphic column of the Osgood Mountain Quartzite and Preble Formation. Subjacent strata are not shown. Red dashed lines are approximate system boundaries. The Iron Point normal fault shown is mid-Pennsylvanian. Structural relationships are after Cashman et al. (2011); unit ages are after Hotz and Willden (1964) and Madden-McGuire (1991).
Preble Formation (Lower Cambrian–Lower Ordovician)

The three Preble Formation samples were collected low in the formation (Fig. 3) at Goughs Canyon, Garden Spring, and Golconda Mine (Fig. 2B; Table 1). The samples all contained Paleoproterozoic and Mesoproterozoic age peaks (Fig. 4). Applying the K-S test, we found that within the Preble Formation, the three different sample pairs have P values of 0.849, 0.881, and 0.937. All sample pairs of the Preble Formation and Osgood Mountain Quartzite have P values <0.05.

DISCUSSION

Osgood Mountain Quartzite

The source of the detrital zircon grains in the Osgood Mountain Quartzite samples is Laurentian, and the samples have two distinct provenances. The change in detrital zircon ages from the older Soldier Pass sample to the younger Goughs Canyon and Golconda Mine samples indicates a significant change in provenance during the deposition of the Osgood Mountain Quartzite. The grains from Soldier Pass are predominantly Mesoproterozoic (Fig. 4) and we interpret that their source was the 1.2–1.0 Ga Grenville orogen (Fig. 1). There are also some Paleoproterozoic grains which we interpret to have been derived from the 1.8–1.7 Ga Yavapai province and the 2.0–1.8 Ga Trans-Hudson orogen (Fig. 1). There are a few Mesoproterozoic grains; these are interpreted to have been shed from the 1.48–1.34 Ga mid-continent granite-rhyolite provinces (Fig. 1). Archean grains are interpreted to have been sourced from the Archean craton (Fig. 1). A few Mesoproterozoic grains are interpreted to have been derived from the 1.2–1.0 Ga Grenville orogen (Fig. 1).

Preble Formation

The detrital zircon ages in all three Preble Formation samples are similar (Fig. 4). We interpret that these three Preble Formation samples share a common Laurentian source. Mesoproterozoic grains predominate in all three samples (Fig. 4) and are interpreted to have been shed from the 1.48–1.34 mid-continent granite-rhyolite provinces (Fig. 1). A large number of Paleoproterozoic grains are interpreted to have been derived from the 1.7–1.62 Ga Mazatzal province and the 1.8–1.7 Ga Yavapai province (Fig 1). A smaller number of Mesoproterozoic grains are interpreted as having their source in the 1.2–1.0 Ga Grenville orogen (Fig. 1). The remaining grains are Archean and their source is interpreted as the Archean craton (Fig. 1).
REGIONAL CORRELATION

Detrital zircon ages in passive margin strata across a transect of the Great Basin vary stratigraphically in a manner similar to those we documented within the Osgood Mountain Quartzite, recording a major regional change in provenance.

NEVADA-UTAH BORDER: DEEP CREEK, PIONEER, AND SNAKE RANGES

Detrital zircons from rocks in the Deep Creek, Pilot, and Snake Ranges (Fig. 2A) record a shift of ages similar to that of detrital zircons analyzed in the Osgood Mountains. The older strata are of the Neoproterozoic McCoy Creek Group (Fig. 6). In all three ranges, the McCoy Creek Group has similar Mesoproterozoic age groups and peaks (Fig. 5) (Yonkee et al., 2014). We interpret these grains as primarily shed from the 1.2–1.0 Ga Grenville orogen and the 1.48–1.34 Ga mid-continent granite-rhyolite province (Fig. 1). This is similar to the older Osgood Mountain Quartzite (Soldier Pass) sample, which we interpreted to be sourced in these same terranes. The younger strata in all three ranges are the Cambrian Prospect Mountain Quartzite, and in the Deep Creek Range, the Cambrian Busby Formation (Fig. 6). In all three ranges, the detrital zircons in these younger strata have similar Paleoproterozoic and Mesoproterozoic age groups and peaks (Fig. 5) (Yonkee et al., 2014). We interpret these grains as shed from the 1.80–1.70 Ga Yavapai province and the 1.34–1.48 Ga mid-continent granite-rhyolite province (Fig. 1), very similar to the younger Osgood Mountain Quartzite samples.

CENTRAL UTAH: CANYON RANGE

Detrital zircons in Canyon Range strata (Fig. 2A) indicate a shift of ages similar to those analyzed in the Osgood Mountains. The older unit analyzed in the Canyon Range is the Neoproterozoic Caddy Canyon Quartzite (Fig. 4). This unit has Mesoproterozoic age groups and peaks (Fig. 5) (Lawton et al., 2010) that we interpret as primarily from the 1.2–1.0 Ga Grenville orogen and the 1.48–1.34 Ga mid-continent granite-rhyolite province (Fig. 1). These age peaks and our source area interpretation are very similar to those of the older Osgood Mountain Quartzite sample. The younger unit in the Canyon Range is the Cambrian Prospect Mountain Quartzite (Fig. 6). This unit has Paleoproterozoic and Mesoproterozoic age groups and peaks (Fig. 5) (Lawton et al., 2010). We interpret these detrital zircons as shed from the 1.80–1.70 Ga Yavapai province and the 1.48–1.34 Ga mid-continent granite-rhyolite province (Fig. 1), similar to the younger Osgood Mountain Quartzite samples.

NORTHEASTERN UTAH: HUNTSVILLE

Detrital zircons from Huntsville samples (Fig. 2A) record a shift of ages comparable to those analyzed in the Osgood Mountains. The older units in the Huntsville section are the Neoproterozoic Kelley Canyon and Mutual Formations and the Neoproterozoic–Cambrian Brown’s Hole Formation (Fig. 6). The Kelley Canyon Formation (Yonkee et al., 2014), the Mutual Formation (Stewart et al., 2001; Yonkee et al., 2014), and the Brown’s
Figure 6. Stratigraphic columns of the passive margin strata discussed in text. Subjacent strata are not shown. Neoproterozoic-Cambrian boundary at 540 Ma is approximated for each location. Strata in the Osgood Mountains are shown in stratigraphic succession and are correlative with regional passive margin strata. Only the detrital zircon samples referenced in the text are shown. Abbreviations: Mtn—mountains; Qtz—quartzite; Fm—formation; Gp—group; Cyn—canyon; SS—sandstone.

Hole Formation (Yonkee et al., 2014) have similar Mesoproterozoic age groups and peaks (Fig. 5). We interpret these grains as primarily derived from the 1.2–1.0 Ga Grenville orogen and the 1.48–1.34 Ga mid-continent granite-rhyolite province (Fig. 1), very similar to our older Osgood Mountain Quartzite sample. The younger unit in the Huntsville section is the Cambrian Geersten Canyon quartzite (Fig. 6). The Geersten Canyon quartzite (Stewart et al., 2001; Yonkee et al., 2014) has Mesoproterozoic, Paleoproterozoic, and Archean age groups and peaks (Fig. 5). We interpret these grains as derived primarily from the 1.80–1.70 Ga Yavapai province and secondarily from the 1.2–1.0 Ga Grenville orogen and the 2.5 Ga and older Archean craton (Fig. 1). These age peaks and our interpreted provenance are similar to that for our younger Osgood Mountain Quartzite samples.

Southeastern Idaho: Portneuf Range

Detrital zircons from rocks in the Portneuf Range (Fig. 2A) record a shift of ages similar to those analyzed in the Osgood Mountains. In the Portneuf Range, the older unit is the Neoproterozoic Middle Caddy Canyon Quartzite (Fig. 6). The Middle Caddy Canyon Quartzite has Mesoproterozoic age groups and peaks (Fig. 5) (Yonkee et al., 2014). We interpret these grains as primarily shed from the 1.2–1.0 Ga Grenville orogen (Fig. 1). These age peaks and our source area interpretation are very similar to that of the older Osgood Mountain Quartzite sample. The younger unit in the Portneuf Range is the Windy Pass Argillite, comprising upper and middle members (Fig. 6); both members have Paleoproterozoic age peaks and groups (Fig. 5) (Yonkee et al., 2014). We interpret these grains as shed from the 1.80–1.70 Ga Yavapai province (Fig. 1). This is very similar to the younger Osgood Mountain Quartzite sample.

Implications of the Regional Correlation

In the five areas of the passive margin examined, the detrital zircon age patterns change in a systematic way (Fig. 7). The detrital zircons of the older strata are predominantly the age of the Grenville orogen and the detrital zircons of the younger strata are predominantly the age of the Yavapai province basement rocks.

The shift in detrital zircon age across the region implies a provenance change across the region at approximately the same time. Conti...
Detrital zircon geochronology of the Osgood Mountain Quartzite and Preble Formation in Nevada

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SUMMARY AND CONCLUSIONS

U-Pb analyses of detrital zircons from the Osgood Mountain Quartzite and the Preble Formation in northern Nevada demonstrate that these units were shed from sources within the North American craton, and that the sources changed with time. The oldest sample of the Osgood Mountain Quartzite, taken near Soldier Pass, was derived primarily from the Grenville orogen. The younger Osgood Mountain Quartzite samples were derived primarily from the Yavapai and Mazatzal provinces. The stratigraphically overlying Preble Formation was also derived primarily from the Yavapai and Mazatzal provinces.

The shift in age peaks and groups of detrital zircons within the Osgood Mountain Quartzite section is also recorded in other passive margin strata in Nevada, Utah, and Idaho. This shift indicates a widespread change in provenance; the older passive margin units were derived primarily from the Grenville orogen and the younger units were derived primarily from the more proximal Yavapai and Mazatzal provinces.

Our data support the proposal that the Transcontinental Arch, a continent-scale crustal feature that was not present in the middle Neoproterozoic, was uplifted in the latest Neoproterozoic or earliest Cambrian. The uplifted arch provided vertical relief, and forced a change in sedimentation and drainage patterns, restricting the transport of sediment from the Grenville orogenic terrane to western Laurentia. This gradual change in drainage patterns caused the observed dearth of Grenville-age zircons.

The uplift of the arch also would have exposed basement rocks of the Archean craton, the Trans-Hudson orogen, the Yavapai and Mazatzal terranes, and the mid-continent anorogenic granites (Fig. 1). Sloss (1963) demonstrated that the Sawk sequence onlapped basement rocks by middle Cambrian time; this onlap requires that the basement rocks were exposed. These uplifted and exposed basement rocks became the sources for the sediments draining from the western flank of the Transcontinental Arch to the western Laurentian margin. The uplift of the arch caused the preponderance of zircons of the age of the Trans-Hudson orogen and the Yavapai, Mazatzal, and mid-continent granite provinces in the younger passive margin strata investigated in this study.

Across the Great Basin transect investigated for this study, the definitive shift in detrital zircon age spectra records a tectonic event that caused a coeval change in sediment transport patterns. This detrital zircon age shift therefore could be a useful correlation tool. Such a tool would be particularly helpful in dating quartz arenites, which are often lacking in biostratigraphic markers and thus difficult to date with confidence. We suggest that stratigraphic sections documented by our work and others can be correlated based on this consistent change in detrital zircon age peaks, and that other sections in the region can also be correlated in this way.

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APPENDIX 1. STATISTICAL ANALYSIS OF OSGOOD MOUNTAIN QUARTZITE SAMPLES

A visual scan of the Goughs Canyon and Golconda Mine relative probability graphs (Figs. 6 and 7) reveals similar age peaks, with similar numbers of grains, ca. 1700 Ma. Both of these graphs also show peaks ca. 2500 Ma and 2900 Ma, although different numbers of grains form the peaks. The K-S statistical test found very low correlation (P < 0.05) between these two samples when we compared the entire data set for each sample. However, the K-S test is very sensitive to proportions of ages, and as with these samples, will indicate no or low correlation, although a visual examination coupled with geologic understanding indicates the contrary, i.e., a high likelihood of common sources (Gehrels, 2012). Within the Osgood Mountain Quartzite, we used the K-S statistical test to compare the distinct Neoproterozoic and Archean grain subpopulations. The correlation between the Goughs Canyon and Golconda Mine Neoproterozoic subpopulations was 0.957, while the correlation between the Archean subpopulations of these two samples was 0.174. This comparison of subpopulations allows us to account for the different proportions of grains of similar ages that would otherwise indicate no correlation.

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