Sources of Upper Permian Sedimentary Rocks in the BogdaMountains, NW China

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Abstract. Both distant Tianshan suture zone and proximal local horsts are possible sources of Upper Permian sedimentary rocks exposed in the BogdaMountains. The Abundance of volcanic grains indicates the former was the main source. Paleocurrent direction further suggests the sole main source located to the south, which is consistent with that the Tianshan suture zone is the main source. Sandstone petrographic data show two petrofacies, A and B (QFL = 5:7:88 and 32:8:60). The change from A to B suggests that the Tianshan suture zone evolved from an undissected to a transitional arc during unroofing; upsection increase of phaneritic clasts (from 3 to 14%) in conglomerates supports the interpretation.

1. Introduction

The composition and texture of sediments filling a half-graben can be used to infer the lithology, location, and unroofing history of sediment source(s). The Tarlong-Taodonggou half-graben was developed in a shear-related rifting zone, and was filled with fluvial-lacustrine sediments during Permian [1, 2]. Both distant Tianshan suture zones and local horsts were possible sources. Petrographic, paleocurrent, and stratigraphic data are used to evaluate the relative contributions from the two sources, and to reconstruct the unroofing history of the main source.

2. Methodology and Data

A 424-m-thick stratigraphic section was measured at a cm-dm scale. On the basis of lithology, sedimentary texture and structure, stratal contact and vertical stacking pattern, depositional environments are interpreted; and 214 high-order cycles (HCs) are defined by systematic environmental changes and classified into three categories – meandering stream, lacustrine delta, and lake margin-littoral. Lithology and tectonic setting of sources are inferred through sandstone and conglomerate petrography. 1500 point-counts from five lithic arenites show two petrofacies, A and B, with QFL ratios of 5:7:88 and 32:8:60, respectively (Fig. 1). Petrofacies A occurs in four deltaic/littoral lithic-arenites in the lower ~320 m; petrofacies B in one deltaic lithic-arenite in the uppermost part of the section. Lithic grains are dominantly felsic, intermediate, and mafic volcanic grains. 2060 point-counts from four conglomerates are dominantly igneous clasts (96%), among which phaneritic clast increases upsection from 3 to 14%. 134 paleocurrent data were collected from tabular and trough cross-beddings, groove marks, parting lineations, asymmetric ripple marks, oriented petrified wood, and imbricated clasts (Fig. 2). The mean paleocurrent direction is 350º; and the mode is in the range of 320-340º. The mean paleocurrent directions from sandstones containing petrofacies A and B are 355º and 303º, respectively; and those from fluvial and deltaic deposits are 345º and 353º, respectively.

3. Implications

The abundance of volcanic grains in sandstones and conglomerates suggests the Tianshan suture zone as the main source. The rarity of quartz and siliciclastic grains suggests thelocal horsts as a minor source. The presence of metamorphic and chert grains derived from metamorphic and marine carbonate rocks in the Tianshan suture zone supports the interpretation. Moreover, the overall northward paleocurrent direction suggests a single source to the south, where the Tianshan suture zone was located.

Petrofacies A indicates the Northern Tianshan as an undissected arc in the suture zone, whereas petrofacies B indicates a transitional arc [3]. The change from A to B suggests the removal of volcanic cap and gradual exposure of the underlying batholitic basement, as indicated by the increase in phaneritic clasts, during the process of unroofing of the Tianshan suture zone. The difference in paleocurrent direction between petrofacies A and B suggests that they may have had different areas within the suture zone. The more diverse paleocurrent directions of deltaic deposits in comparison to fluvial deposits may have been caused by distributary flows on delta plains.

4. Conclusions

Sediments in the Tarlong-Taodonggou half-graben were mainly derived from the distant Tianshan suture zone. The contribution from local horsts is negligible. The unroofing of North Tianshan arc occurred first by removal of the volcanic cap, followed by gradual exposure of the batholitic basement during Late Permian.

5. Acknowledgements

We thank J. Li, Y. Yang, X. Cheng, H. Tian, W. Chen, D. Fu, W. Li for field assistance in the summers of 2008 and 2009. The project was partially supported by AAPG Grants-in-Aid, Dora Wallace Hodgson Summer Graduate Research Grants from WichitaStateUniversity, and Kansas Geological Foundation. We are grateful to Dr. Wan Yang's mentoring and encouragement.

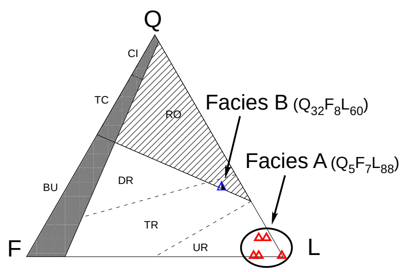

Figure 1. Ternary diagram showing QFL composition of sandstone framework grains. Two petrofacies are recognized on the basis of their distribution on the ternary diagram. Petrofacies A falls within undissected arc region, suggesting a source area of volcanic arc during its initial unroofing stage; petrofacies B within transitional arc region, suggesting underlying intrusive rocks were partially exposed [3]. CI: craton interior; TC: transitional continental; BU: basement uplift; RO: recycled orogen; DR: dissected arc; TR: transitional arc; UR: undissected arc

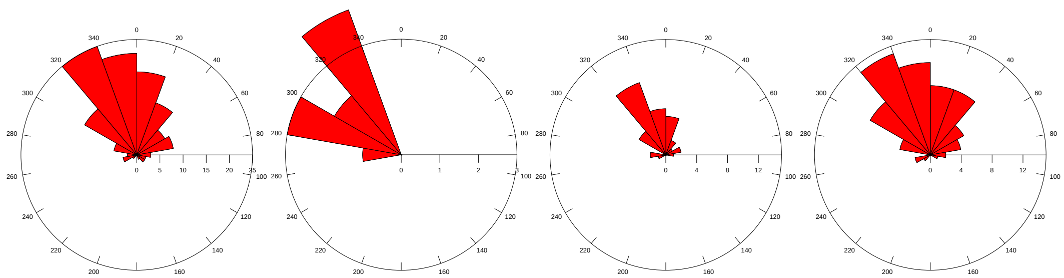

Figure 2. Rose diagrams showing paleocurrent directions from petrofacies A and B, and fluvial and deltaic deposits.

The references

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