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Distribution of three key Early Permian fossil groups in western USA and northern Mexico and their relevance to interpretation of paleotectonic features along the southwestern margin of Laurentia

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ABSTRACT

Three species groups, including two groups of corals and one of fusulinids, delineate the zone of favorable marine environments for these animals along the shelves bordering southwestern Laurentia during the Cisuralian (Early Permian). The three species groups are: the coral *Protowentzelella* group of late Asselian to early Sakmarian age, the fusulinid *Eoparafusulina linearis* group of late Sakmarian age, and the coral *Pararachnastraea illipahensis* group of late Artinskian to Kungurian age. Occurrences of these three species groups clearly outline most of the major paleotectonic features that were present along the southwestern margin of the Laurentian shelf at that time. The paucity of data in Mexico, however, leaves open the question of large-scale displacement on the Mojave–Sonora megashear, a feature proposed to cut across northern Mexico and southwestern USA, although the data presented here could be construed to suggest lack of significant displacement in post-Pennsylvanian time.

1. Introduction

Permian rocks deposited along the southwestern margin of the North American craton from southern Idaho to West Texas (southwestern Laurentia) contain shallow-marine faunas showing some differences from location to location, but also many similarities (e.g. Stevens and Belasky, in press). Three very distinctive Early Permian species groups, which have very widespread distribution, can be used to ascertain the limits of habitats favorable for these fossils on the warm, shallow-water shelf that bordered the southwestern margin of Laurentia and to outline the major paleotectonic features present along that margin during that time; two are coral species groups, and one a fusulinid species group. The coral species groups are here referred to as the *Protowentzelella* and *Pararachnastraea illipahensis* species groups. The fusulinids are represented by the *Eoparafusulina linearis* species group.

2. Geographic distributions

On a world scale the *Protowentzelella* species group forms an intermittent band stretching from just north of the Caspian Sea, to Texas, and possibly South America (Stevens, 1982), by way of the Ural Mountains, Spitsbergen, the Canadian Arctic Islands, and the western margin of North America. In western USA the *Protowentzelella* species group forms an almost continuous belt extending from southern Idaho into southeastern California where it is terminated. This belt reappears in westernmost Texas and southern New Mexico (Fig. 1A).

The *Eoparafusulina linearis* species group mostly follows the path of the *Protowentzelella* species group in northeastern Nevada, southeastern California, and westernmost Texas. However, it also extends farther southeastward in Texas and it has been found at several localities in south-central Sonora, Mexico (Fig. 1B).

The *Pararachnastraea illipahensis* species group occurs at many fewer localities than the other two species groups, but its distribution generally follows that of the other species groups. This species group is present in northeastern Nevada, in southeastern California, and from wells in southern New Mexico. In northwestern Chihuahua it occurs in a coarse-grained limestone gravity-flow deposit (Stevens, 1995; Fig. 1C).

3. Age and stratigraphic positions

The *Protowentzelella* species group apparently first appeared in the early Asselian (Fedorowski et al., 2007) and was shown by them to have persisted through the early Artinskian. More recently Stevens and Stone (2009b) recorded a single specimen from rocks considered late Artinskian or Kungurian in age. The vast majority of species of the genus, however, are early Sakmarian in age (Fedorowski et al., 2007) which appears to be the time that species of this genus became most widespread. In the contiguous USA these corals occur in the Trail Canyon Formation in southern Idaho; the Riepe Spring Limestone and Ferguson Mountain Formation in northeastern Nevada and adjacent

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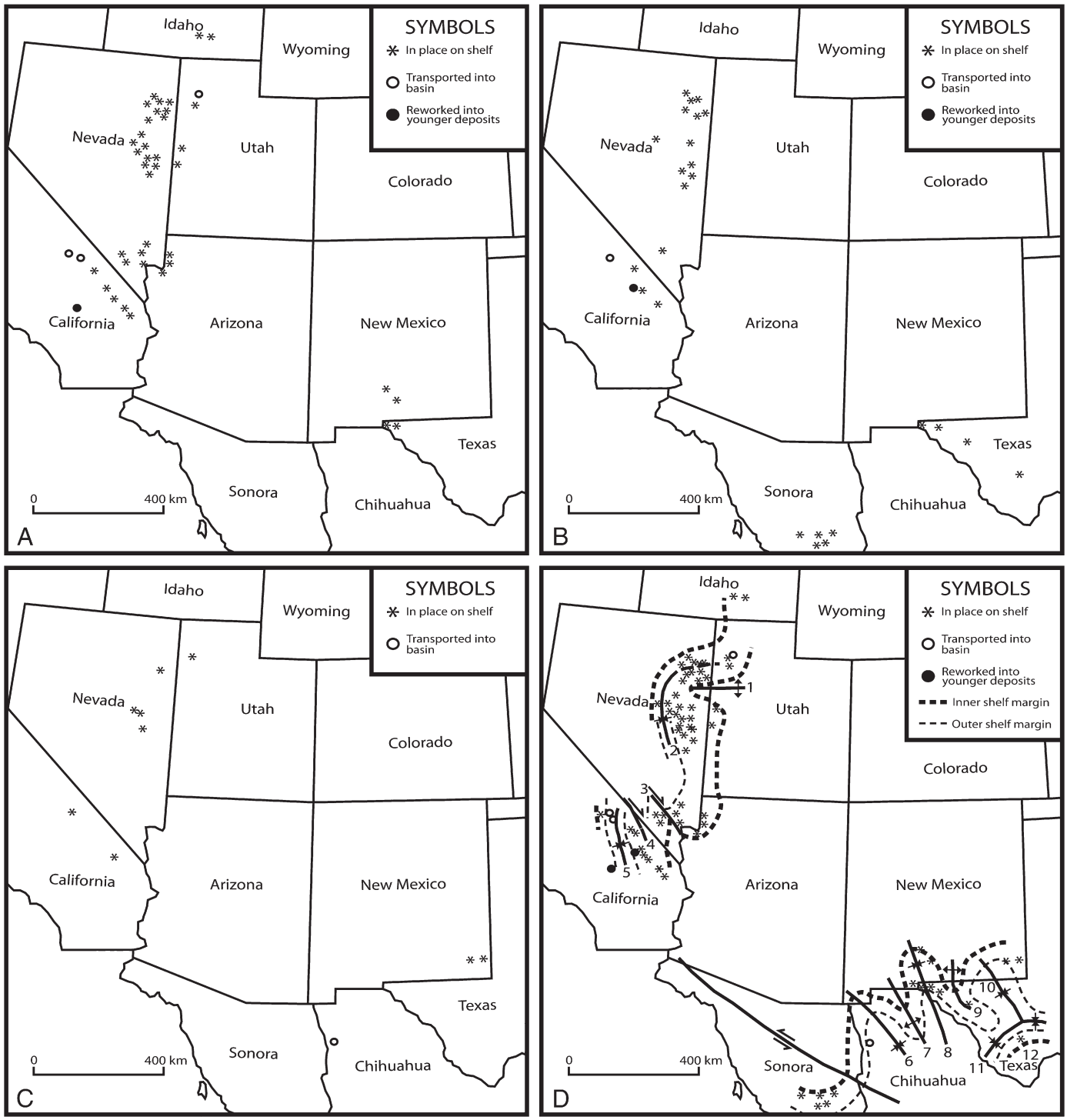

Fig. 1. A. Distribution of the *Protowentzelella* species group in western USA. For origin of data see Appendix A. B. Distribution of the *Eoparafusulina linearis* species group in western USA and Mexico. For origin of data see Appendix A. C. Distribution of the *Pararachnastraea illipahensis* species group in western USA and Mexico. For origin of data see Appendix A. D. Paleogeography of the shelf margins of southwestern Laurentia during the Early Permian showing major uplifts and depressions. 1, Deep Creek–Tintic Uplift and 2, Dry Mountain Trough, of Stevens (1979); 3, Las Vegas shear zone and 4, Death Valley–Furnace Creek fault zone with displacements from Stevens et al. (1991); 5, Darwin Basin of Stevens and Stone (2007); 6, Pedregosa Basin, 7, Florida Uplift, 8, Orogrande Basin, 9 Pedernal Uplift, 10, Delaware Basin, 11, Hovey Channel, and 12, Marathon Uplift. Locations of features 6–12 are based on maps of Babcock (1977), Peterson (1980), and Wilson (1987).

Utah; the Bird Spring Formation in southern Nevada, southeastern California, and equivalent rocks in northeasternmost Arizona; and the Hueco Canyon Formation in West Texas and adjacent New Mexico (Fig. 2).

In southeastern California species of *Protowentzelella* occur in fusulinid zone 3 of Stevens and Stone (2007), considered by them to range from latest Asselian to middle Sakmarian in age. In northeastern Nevada this coral zone is represented in the Riepe Spring Limestone, the uppermost part of which has yielded early Sakmarian conodonts (Wardlaw et al., 1998). Corals here probably span late Asselian to early Sakmarian time. In the Hueco and Franklin mountains in westernmost Texas these corals occur in the Hueco Canyon Formation in beds considered similar in age to those in fusulinid zone 3 in the Bird Spring Formation (Stevens and Stone, 2007). Thus, these corals