current lineation. Such reversals also may be seen in turbidites reflected or deflected by fault scarps or in narrow basins (Pickering and Hiscott, 1985) but can hardly be expected to occur in the ancient Gulf of Mexico in turbidites over such a vast area.

4. The uniqueness of the sandstone complex within long tracts of Cretaceous marl and Paleocene marls without turbidites (or only very distal ones such as at Rancho Nuevo) between exactly the latest Cretaceous and earliest Paleocene marls and characterized by spherules at the base and high Ir concentration at the top of the sandstone unit.

5. The absence of longer time intervals between the beds as may be deduced from the lack of interbedded mud (except for Unit 3 at the top) and intercalated bioturbated levels. The only instance where we found two burrow levels separated by a scarcely burrowed sandstone bed was in the top of the K/T sandstone complex at El Peñon. However, we found that the horizontal star-shaped tube systems are connected to vertical tubes in the center, penetrating through several-decimeters-thick sandstone layers above the star-structure. Although we have not observed these vertical tubes to penetrate to the surface of the sandstone complex, there is no evidence to the contrary.

6. Channel cut and channel fill occurred directly after each other, as is indicated by only shallow downcutting in the order of 0.5 m, followed by meters-deep loading with upward-decreasing intensity of plastic deformations. Such fills were observed at Mimbral in Unit I and partially in Unit II and at Rancho Nuevo and Ramones in Unit II. Injection dikes with spherules in the Mendez Formation likewise point to connected cut-and-fill events at Lajilla and Moscow Landing. Rapid sedimentation is further indicated by water-escape structures and sand-in-sand loading at Rancho Nuevo, Ramones, and El Peñon.

7. The occurrence of mud clasts sparsely armored with spherules at the base of Unit II. These mud lumps just before sedimentation of Unit II sands were struck by the current, leaving minute, oriented current-crescents upstream of the spherules. These unique features were seen at Ramones, La Sierrita (Alvarez et al., 1992b), and Rancho Nuevo; they indicate a short time lapse between Units I and II. At Sierrita such an armored mud clast was picked up by the current and deposited in Unit II in a clear traction carpet (Lowe, 1982; Mutti and Ricci Lucchi, 1972) in the sandstone.

In conclusion, the general fining-up and thinning-up of the beds; the unique occurrence at the K/T boundary; the (impact-derived) spherules at the base of the unit, shelf-derived sand in the middle, and (cosmic) Ir concentration at the top; the relatively thin deposit but widespread occurrence; and rapid deposition by opposing and deviating currents cannot be explained by deposition in a turbidite fan or series of fans. On the contrary, these arguments fit well an impact scenario with associated tsunami deposits at the K/T boundary.

However, especially in the shallow-water areas of Alabama and Texas, other noncatastrophic factors such as eustatic sea-level changes have contributed locally to the final architecture of the sandstone units. An early, but not earliest, Danian sea-level lowstand may explain many features of the K/T boundary in the Gulf coastal plain and elsewhere. It is common knowledge that the K/T boundary at shallow-marine settings contains a hiatus due to erosion. Figure 24 shows the possible interactions of early Danian eustatic sea-level changes in the Gulf Coast sections (after Mancini and Tew, 1993). The onset of the sea-level drop is hard to estimate, but some biostratigraphic data are available. The burrows of the transgressive surface, in Brazos River and at Moscow Landing, are of *M. pseudobulloides* age. The low-stand phase has locally eroded down into earliest Danian, K/T sandstone complex, or Late Maastrichtian sediments, as shown at Moscow Landing. Some remnants of the low-stand (ravinement valleys, Habib et al., 1992; Habib and Talvirska, 1994) are still preserved in Moscow Landing and Mussel Creek but should not be confused with the K/T sandstone complex. These low-stand infills contain earliest Danian dinoflagellates. Also, as seen in the grain-size analysis of Brazos River (Fig. 7), there is a coarsening-upward trend in the top of the sequence, where the first *G. eugubina* appear and where Jiang and Gartner (1986) first found the basal Danian *Crucoplacolithus primus*.

Some have expressed doubts that the clastic beds are related to the Chicxulub impact, or have a bearing on the mass extinction of, among others, planktic foraminifers (Stinnesbeck et al., 1993, Keller et al., 1993; Jéhanno et al., 1992). Keller et al. (1994b) presented relative abundance plots of planktic foraminifers in the Mimbral section, suggesting the continuation of "thriving" planktic populations above the clastic beds. However, comparison of thin sections from pelagic marls just below (Figs. 12F, 14A, H) and above the clastic beds (Figs. 12E, 14C, G) clearly show that the Cretaceous planktic populations were decimated just above the clastic beds. The few Cretaceous specimens present are for the largest part most likely reworked, because they occur in cross-bedded sediments. But even if some of these were survivors, then their ecological significance in the planktic populations above the clastic beds is negligible.

CONCLUSIONS

The set of sandstone beds as found in intermediate water depths (50 to 500 m) in Gulf Coast outcrops from Alabama to Chiapas, Mexico—designated here as the K/T sandstone complex—is best explained as a deposit of large tsunami waves, caused by the impact of a large extraterrestrial body at Chicxulub, Yucatan, Mexico.

The resulting sequence of sedimentary events is as follows:

1. Seismic shaking of the Chicxulub impact locally caused faulting and slumping (Moscow Landing, La Lajilla, Mimbral) and triggered thick mass-flows (Bochil, Mexico, Guatemala).

2. During the earthquakes, or shortly afterward, coarse ejecta (tektites, limestone clasts) fell down around the Gulf of Mexico.

3. These ejecta were immediately reworked with local (rip-up) material into channel-like deposits by currents caused by