ssively eastward
narily related to
(CAI) can be easily
boratory experiments,
cess and is chiefly

-alteration data
The data suggest
ic conditions at
0°C.
conodonts (CAI=1 to
<1 (<70% fixed
>95% fixed carbon).
lurian-Middle Devon-
hian basin show:
and CAI; 2) Within
occurring near the
of CAI=2; 4) Sev-
the Valley and Ridge,

assessing oil and
Triassic age because:
om carbonate rocks;
tandard picking
be rapidly assem-
-term, high-temper-
Conodonts persist

era, University of

EASTERN SPAIN)

alluvial-fan and bay
d marine lagoon
etaceous basement.
transgressive-
h reef, mud bank
facies consists
ites, and
y Tarbellastrea
, forming a central
nd small bioherms
own by the massive
nd encrusting
orings: evidence of
sh calcarenites
. Except for some
e are absent. Sant
sedimentologic

, Urbana, Illinois
niversity of Kentucky,

DDLE AND LATE MISSIS-

y features and facies
have been influenced
tivity occurred along
fault. Both were
ian. The arch has been

410

described as an axis of persistent relief (or resistance to subsidence), and the fault is part of a right-lateral transverse fault system.

The lower Newman Group exhibits four separate marine invasions, the earlier of which were interrupted by uplift along the Waverly Arch. The oldest unit (St. Louis) was deposited over the entire area before uplift; the subsequent three units show progressive northeasterly overlapping, depositional thinning toward the axis of the arch, and restriction to the flanks of the arch. There is also apparent depositional restriction of one unit (Ste. Genevieve) by activity on the basement fault system. The periods of uplift caused subaerial exposure of the previously deposited unit, resulting in the formation of subaerial exposure features including exposure crusts, tee-pee structures, brecciation, caliche, and small paleokarst.

The upper Newman Group contains a final marine invasion which successfully covered the arch. Depositional thinning on the arch, different facies on either side of the arch, and the near-shore, shallow-water aspect of the upper Newman Group itself indicate that the region surrounding the arch was still undergoing some uplift during deposition of the upper Newman Group. Some facies distribution in the upper Newman Group is also attributed to renewed activity along the basement fault system.

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ENERGY MINERALS--THE NEXT GENERATION

Coal is the predominant energy mineral today, and the only one with the potential for a significantly larger role by 1990. To a greater or lesser degree, new technologies will be required before energy from uranium, geothermal steam, oil shale and tar sands could fill a major share of the Nation's needs. If America is to reduce her dependence on imported fuels we must double our coal output by 1985.

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SECULAR VARIATIONS IN OCEANIC CIRCULATION

One of the characteristics of the earth as we know it is a rapid turnover of the oceans, on a time-scale of 1,000 to 2,000 years. Coupled with cold bottom waters, this provides animal-supporting aerobic water masses and bottoms in all but local silled basins, and results in relatively highly oxidized sediments. We ask whether this has been a steady and persistent state, or whether the ocean has alternated between a more sluggish mode tending to anaerobism and an actively convecting, oxidizing one. Such modes should be recognizable in sediments by widespread differences in oxidation state and bottom population, in patterns of biogenic and chemical sedimentation, in patterns of submarine erosion, in the composition of plankton, and in sulfur isotope ratios. A preliminary survey of these suggests to us that the oceans have fluctuated in this manner, with a period of about 30 million years. The most sluggish time since the Jurassic seems to have been the Albian, the most convective one the Paleocene. We suggest that the cause lies in changes of marine temperatures and circulation patterns, engendered largely by changes in global climate. Other factors such as the distribution of and communication between ocean basins may have played a role.

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NATURAL HAZARDS AND COASTAL ZONE MANAGEMENT