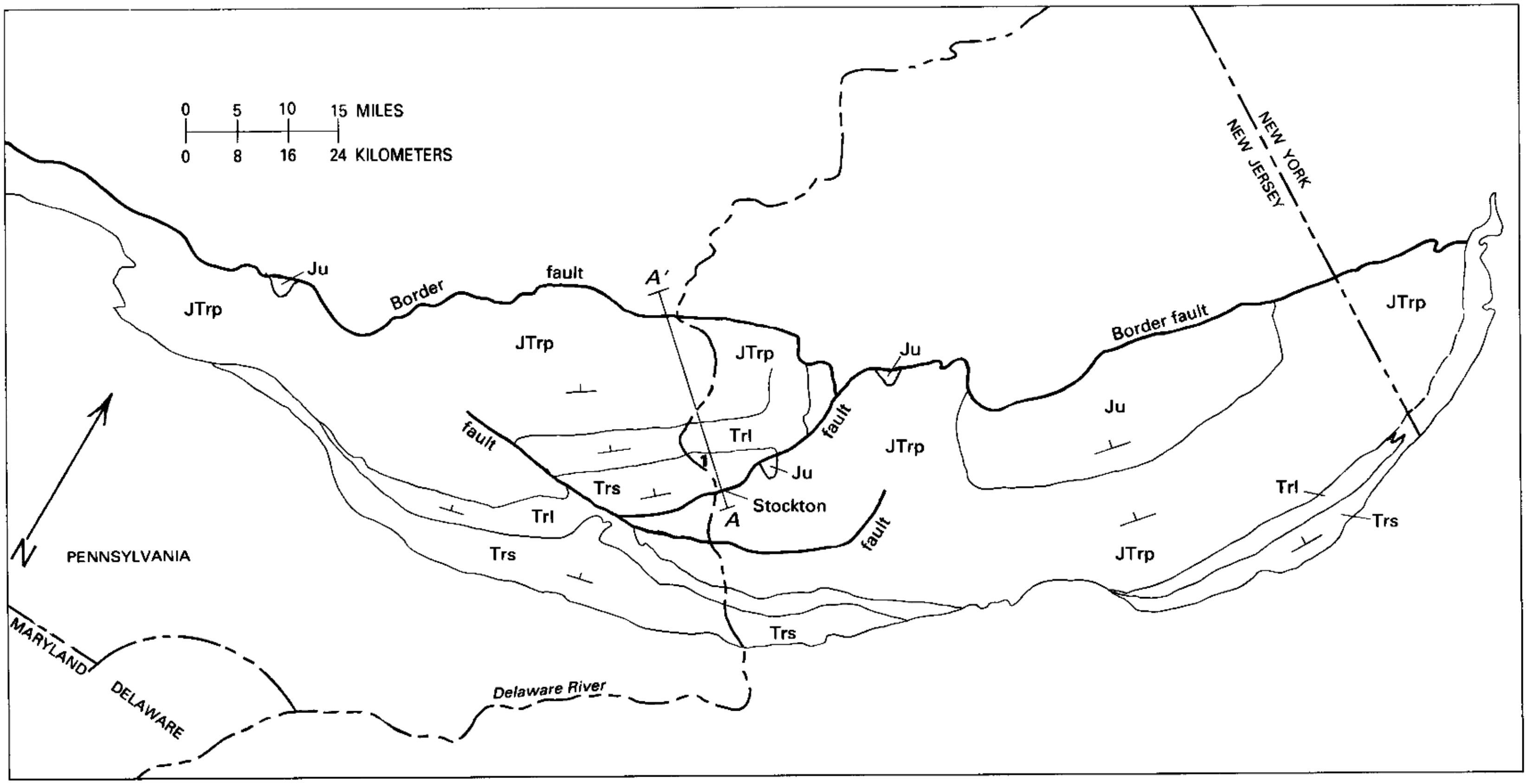

FIGURE 24.1.—Generalized geologic map of Newark basin (modified from Glaeser, 1966). Units dip to the north and northwest toward the northern border fault, and the section is repeated by faulting near the Delaware River. The stratigraphic units shown are the Stockton (Trs), Lockatong (Trl), and Passaic (JTrp) Formations and the Jurassic basalts and interbedded sedimentary rocks, shown here as Jurassic undifferentiated (Ju). Location 1 shows site of a newly discovered uranium anomaly in a gray mudstone of the Stockton Formation (see table 24.1). Cross section *A–A′* shown in figure 24.2.

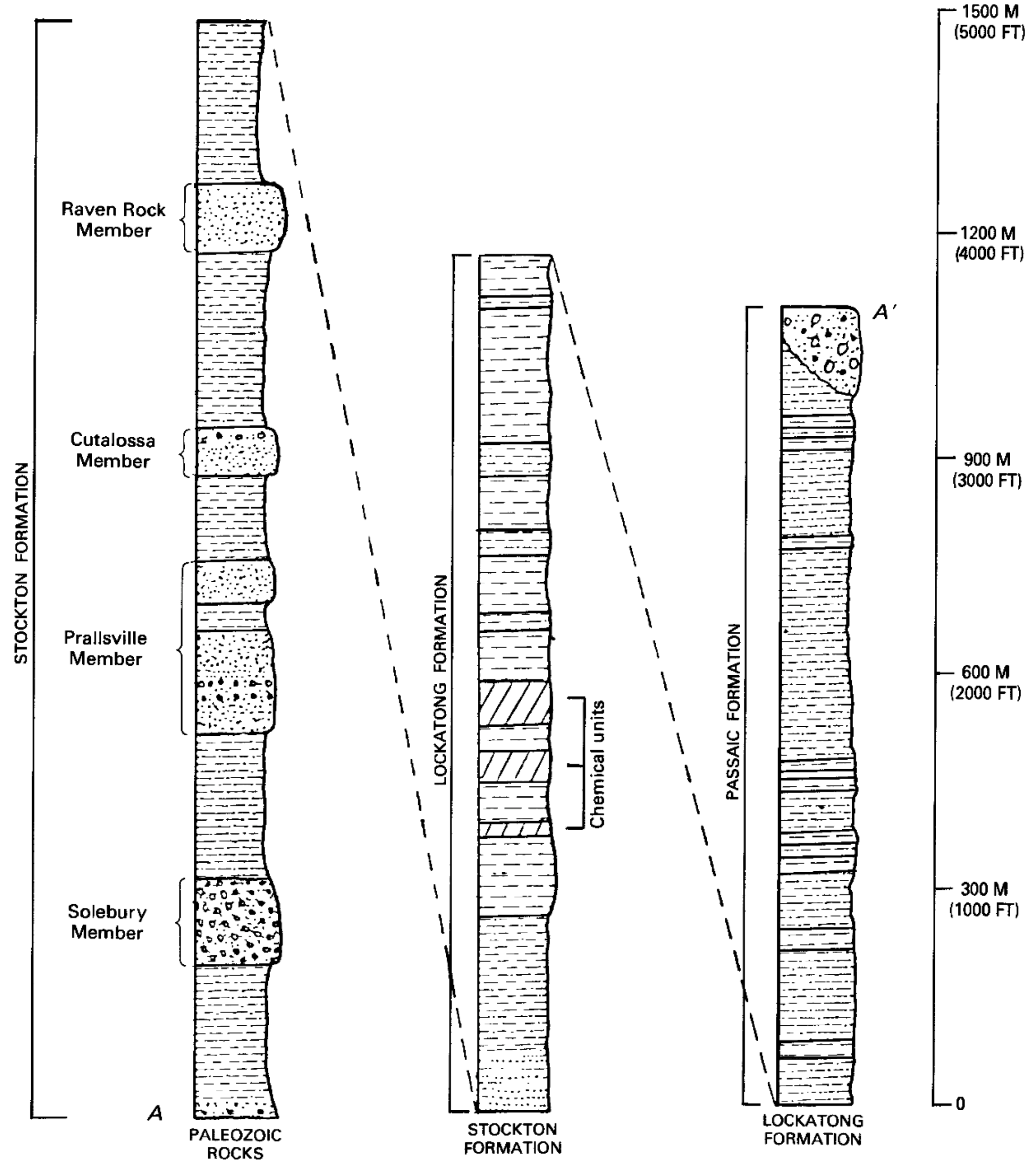

FIGURE 24.2.—Stratigraphic section of the Newark Supergroup along the Delaware River from Stockton, N.J., northward (modified from Van Houten, 1969). Section measured along *A–A′* (fig. 24.1).

organic material that is characterized by numerous oxygen-bearing functional groups has a greater affinity for metals than do other types of organic material (Schnitzer and Khan, 1978). Humic substances, in particular, are known to be effective concentrators of uranium (Szalay, 1958), whereas hydrocarbons generally are not (Andreyev and Chumachenko, 1964). New data indicate that many of the Jurassic lacustrine beds in the Newark basin have organic characteristics and thermal maturity making them suitable as hydrocarbon source beds (Olsen, 1984; Hatcher and Romankiw, chapter 11, this volume; Pratt and others, chapter 13, this volume), but humic substance contents in these samples are low, and thus these beds are not favorable for uranium mineralization. Lacustrine beds in the Triassic Lockatong Formation also contain only small amounts of terrestrial plant material and thus are inferred not to contain much humic material. In fact, visual examination of the kerogen in typical black mudstone of division 2 in the Lockatong Formation shows that detrital plant debris makes up only a minor fraction of the total organic material present (Olsen, 1984). However, the presence of thin coaly beds and detrital plant fragments in other parts of the basin indicates that humic-substance-producing organic material (terrestrial plant debris) was available and present in the lake basin. Visual inspection of kerogen from the Stockton anomaly site during vitrinite reflectance studies showed that type 3 (terrestrial plant material derivative) is abundant in the samples enriched in uranium (table 24.1). Even though the organic matter in the Stockton anomaly is apparently rich in humic substances favorable for fixing uranium, it is unclear at this point whether the organic matter played an active role in the fixing of uranium. Fixation of uranium could occur by complexing with humic matter or by precipitation in response to reducing conditions near the sediment-water interface. The mechanism is of particular concern as the Lockatong uranium occurrences are in black mudstones that apparently do not contain large quantities of terrestrial plant debris, which contribute humic substances. The extremely high grade (0.29 percent uranium oxide) of the Stockton black mudstone, however, may reflect the influence of an unusual abundance of terrestrial plant material in this particular unit.

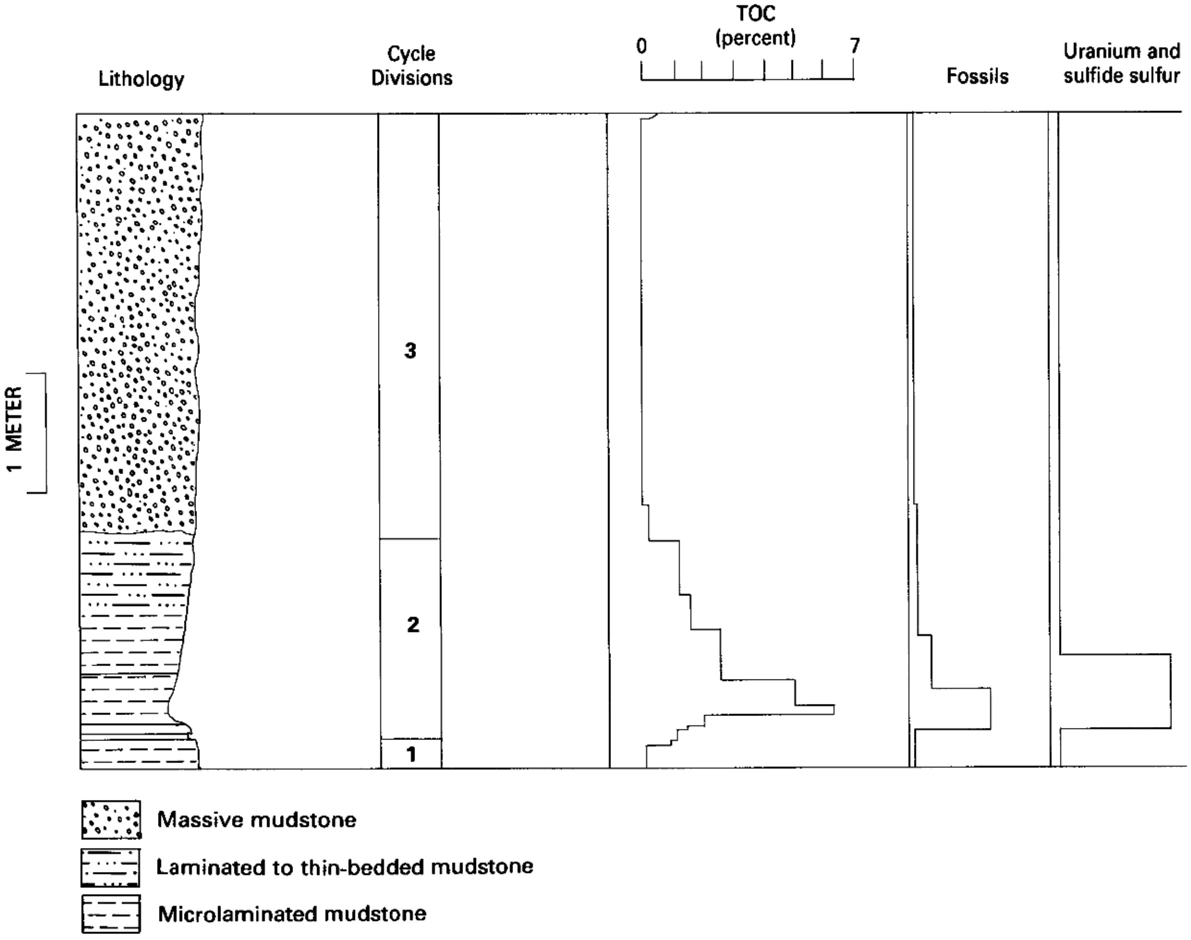

FIGURE 24.3.—Typical detrital cycle in the Lockatong Formation. Note that total organic carbon (TOC) is highest in division 2. Most uranium anomalies in this formation are associated with the lower part of division 2, which commonly contains coprolites, conchostracans, ostracodes, and fish remains. TOC values are from Olsen (1984). Fossil content is intended to be schematic and is summarized from Olsen (1984). Uranium and sulfur contents are also schematic.

TABLE 24.1.—*Vertical section (120 cm) across zone of uraniferous mudstone in the Stockton Formation. Units generally 2.5–15 cm thick; sample 6 is from a 2.5-cm-thick unit. See figure 24.1 for location*

[U_3O_8 in percent; determined by delayed neutron activation analysis. Organic carbon in percent; determined by difference (total organic carbon minus carbonate carbon). Vitrinite reflectance in percent; —, not determined]

Sample number	Lithology	U_3O_8	Organic carbon	Vitrinite reflectance
13	Dark red siltstone	<0.01	0.02	—
12	Medium gray mudstone	<.01	.03	—
11	Medium gray mudstone	<.01	.02	—
10	Medium gray mudstone	<.01	.02	—
9	Medium gray sandstone	<.01	.03	—
8	Dark gray siltstone	<.01	<01	—
7	Dark gray siltstone	<.01	.08*	—
6	Medium gray claystone	.29	.10**	—
5	Black mudstone	.04	.66**	0.68
4	Light gray claystone	.01	.05	—
3	Black mudstone	.01	.33	1.15
2	Light gray claystone	<.01	.10	—
1	Black mudstone	<.01	.23	.66

*Contains plant fragments. **Contains conchostracans.

CONCLUSIONS

Some Triassic black lacustrine mudstones of the Newark basin are rich in uranium, with contents commonly in the range of 0.01–0.02 weight percent uranium oxide. High uranium concentrations in these black mudstones correlate with high organic carbon and high total sulfur contents. This uranium enrichment is interpreted to be syndepositional and possibly related to precipitation in response to reducing conditions at the sediment-water interface. The occurrence of uranium enrichment at the same stratigraphic position in the Lockatong Formation at three widely separated localities supports this model.

A newly discovered uranium anomaly in the Stockton Formation is of particular interest because of the high uranium content (0.29 percent U_3O_8). High uranium concentrations occur in gray to black lacustrine mudstones with locally high contents of organic matter, similar to the associations observed elsewhere. This site is distinctive in that the mineralized horizon contains a high proportion of terrestrial organic matter.

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