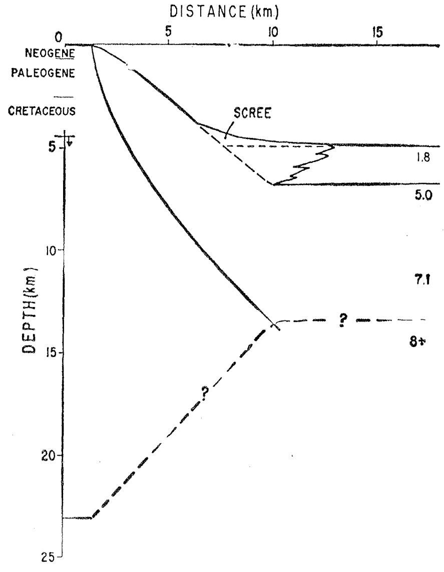

Fig. 4. Hypothetical and schematic reconstruction of the transitional crust east of San Salvador. Stratigraphic column (upper left) inferred from the Andros 1 well. Figures to the right are velocities of P waves in km/sec. These velocities and the thicknesses of the oceanic layers are inferred from data presented in (*8*). Crustal thickness under continental edge is inferred from (*7*). No vertical exaggeration.

scree. The average inclination from the edge of the shelf to the foot of the slope ranges from 14 to 28 degrees, but sustained slopes of more than 30 degrees are common. Thus, in profile 18, the slope drops 3 km (−0.75 to −3.76 km) within a distance of 3.6 km, showing an inclination of 39.7 degrees. This is probably one of the steepest sustained submarine slopes known. It should be noticed that the slope inclinations shown in Fig. 3 are minimal because of the unknown angle between ship track and surface projection of the line of maximum declivity. The hard rock surfaces probably continue beneath the scree to a "basement" perhaps a kilometer below the depth of the Blake-Bahama abyssal plain. The transition between the surface of the slope (including scree if present) and that of the abyssal plain is very sharp in many profiles, but in others is more gradual. Wherever it is sharp, the depth of the margin of the abyssal plain is sharply defined. This depth increases irregularly by about 260 m from northwest to southeast. The crosses in Fig. 1 show the position of the foot of the slope determined by tacking across the margin of the abyssal plain.

The plain visible along the eastern parts of profiles 13 and 14, also seen in profile 15 between 13 and 16.2 km from the western end of the profile, is more than 800 m higher than the adjacent Blake-Bahama abyssal plain. This plain is apparently perched and dammed toward the east by the submarine mounts visible along the eastern portion of profile 15. It slopes slightly (33 m in 20 km) to the north, indicating a southern source for the sediments. The mounts themselves, 600 to 800 m high, pose an interesting problem. On the basis of the single profile available, they could be scree deposits suitably intersected by the ship track, abyssal hills of rather unusual dimensions, or, perhaps more likely, the topographic expression of an outer portion of the basement upon which the entire Bahamian platform was built. If the Atlantic Ocean came into being because the Americas pulled away from Europe and Africa, these features may even be ancient folded mountains deeply eroded by subaerial processes and subsequently depressed to their present depth by subcrustal events. We hope to clarify these structures in the course of future expeditions.

The horizontal distance between edge and foot of the slope ranges from more than 20 km to less than 10 km. The steepest slopes occur off Great Abaco and off San Salvador, in front of the monument to Christopher Columbus (profiles 17 and 18). Here, the average slope (disregarding that of presumed scree deposits) is at least 40 degrees and appears to intersect the landward projection of the surface of the abyssal plain within a horizontal distance of about 6.5 km from the edge of the shelf (Fig. 4). If projected downward, the slope would intersect the surface of the second oceanic layer within a horizontal distance of less than 9 km, suggesting that the oceanic crust may approach the continental crust within this short distance (the oceanward jutting of San Salvador from the regional rim of the Bahamian platform may be relevant here). If this suggestion is substantiated by suitable geophysical investigations, it may be possible to drill and sample a substantial portion of the transitional crust by means of directional drilling techniques from a rig placed at the edge of the shelf (Fig. 4). It may even be possible, at some future time, to cross the entire crust at this location, to pierce the Mohorovičić discontinuity, and to penetrate the mantle.

CESARE EMILIANI

Institute of Marine Science,
University of Miami, Florida 33149

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Tritiated Water as a Tool for Ecological Field Studies

Abstract. *Tritium was used to investigate the withdrawal by small trees of water from soil at three depths. Within 4 hours of placement at each depth, tritium was detected in the transpired water from nearby trees. On the 3rd day after application, 38 times more tritium (per unit volume) was present in transpired water drawn from soil at a depth of 0 to 30.5 centimeters than in water drawn from the 61- to 91.5-centimeter level.*

Tritium is frequently used to trace water movement in soil but has seldom been used for such studies in plants. Its use in ecological field studies also has been almost totally neglected. Here we report the use of tritium to study water uptake by trees growing naturally in the sandhills of South Carolina.

Five curies of tritium in 500 ml of water were introduced to the soil at each of three locations through pipes which had been driven to depths of 66 cm, 35.5 cm, and 5 cm in order to distribute the water to the soil at depths of 61 to 91.5, 30.5 to 61, and 0 to 30.5 cm, respectively. Upward capillary movement necessitated driving the pipes to a greater depth than the minimum level desired for the tritiated water. Although soil moisture was never deficient during the study, the sandy soil permitted complete infiltration within 5 minutes at all depths. For application to the 0- to 30.5-cm depth, the soil was covered with a sheet of plywood, covered with plastic, 1 m by 2 m, to prevent evaporation of tritium into the immediate environment.

Six small trees (*Quercus laevis* Walt., *Q. incana* Bartr., and *Q. stellata* Wang., 1 to 9 m tall) in each plot were selected for sampling; their average distance from points of application of tritium was 2.1 to 2.4 m. Natural diversity of the vegetation precluded exact replication of species and distances.

Transpired water was collected from leaves by enclosing the ends of branches (5 to 20 leaves) in plastic bags (35 by 50 cm) which were sealed to the branch with plastic tape. Although temperatures inside the bags reached 51.5°C the leaves were not killed if the bags were removed each evening; leaves in contact with the bags were killed, however. Water was extracted from the bags with disposable plastic hypodermic syringes; bags and syringes were discarded after one use. We used an estimated 1 percent of the total leaf-surface area available on the trees studied.

Transpired water thus collected was filtered, decolorized with charcoal, and added to a scintillation mixture for liquid scintillation counting. When the liquid scintillation mixtures were "spiked" with a tritium standard and then recounted, a correction factor was obtained which showed that distillation of the water samples prior to counting was not necessary to obtain acceptable counting efficiency.

Polyethylene bags were placed on branches immediately after tritium was applied to the soil (sampling day "0") and were allowed to remain for 4 hours. In each plot, significant quantities of water moved from the soil to the leaves of at least one tree, even in this short period (Table 1), indicating rapid movement of water through the transpiration stream.

The amounts of tritiated water collected in new bags 2 days after application indicated that the rate of uptake of water was relatively much greater in surface roots than in roots in deeper soil. While this was expected, the 38 : 1 ratio of uptake between roots in the 0- to 30.5-cm zone and those in the 61- to 91.5-cm zone was somewhat greater than was expected; a greater root surface area in the shallow zone probably explains the ratio, which would undoubtedly be smaller during periods of drought.

The greatest amount of tritium recovered from one tree on one day was 4 μc per milliliter, which was obtained from a tree in the plot where the tritium had been applied in the shallowest zone. The greatest amount of water transpired by a single tree during a 4-hour period was about 25 ml. At no time was tritium present as atmospheric water vapor in quantities detectable by an extremely sensitive portable "sniffer," an ionization chamber designed specifically for tritium. Once transpired from leaves, water was blown into the surrounding environment with great speed. The large dilution factor also provided a measure of safety for the investigator; no special protective masks and clothing were necessary.

Table 1. Relative amounts of tritium recovered from leaves after tritium-water (5 c/500 ml) was applied to the soil at three different depths. The results are expressed as 10^{-6} μc/ml; each is the average for five trees.

Day of sample collection	Depth of application (cm)		
	0 to 30.5	30.5 to 61	61 to 91.5
−1 (check)	40	47	46
0*	15,700	291	186
1	299,000	10,500	138
2	363,000	19,000	9,500

* Day of application.

Rates of water movement through plants were highly variable and depended on incident solar radiation, which determined temperatures within the plastic bags. Repeated instrument failures prevented collection of radiation data. Only leaves which could be reached without climbing were sampled; in more intensive work it would be desirable to sample all parts of tree crowns.

For useful results the same leaves must be sampled on successive days. This is possible only if the plastic bag collection technique is used, but destructive sampling of leaves can provide precise measurements over short intervals. Although certain atmospheric gases diffuse through polyethylene bags, mass air movement within the bags was slight. The polyethylene-bag technique may therefore be a useful tool for isolating the various components which affect transpiration of large trees, such as air movement and temperature.

FRANK W. WOODS
DENNY O'NEAL
School of Forestry, Duke University, Durham, North Carolina

Note

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Cyanamide Formation under Primitive Earth Conditions

Abstract. *The dimer of cyanamide, dicyandiamide, is formed upon ultraviolet irradiation of dilute cyanide solutions, and by the electron irradiation of a mixture of methane, ammonia, and water. Thus cyanamide may have had an important role in chemical evolution.*

Steinman *et al.* have pointed to cyanamide and its dimer, dicyandiamide, as possible key compounds in chemical evolution (*1*). These compounds cause the formation of pyrophosphate from orthophosphate, glucose-6-phosphate from glucose and orthophosphoric acid (H_3PO_4), and adenosine-5′-phosphate from adenosine and H_3PO_4. In all these reactions appreciable yields (1 to 3 percent) of products were obtained in a few hours from dilute (about 1m*M*) aqueous solutions at room temperature.

If cynamide played a major role in chemical evolution, it must have been formed steadily on primitive Earth. Consequently, we looked for cyanamide formation under "primitive Earth conditions" (such as, ultraviolet irradiation of hydrogen cyanide solutions, ionizing irradiations of mixtures of methane, ammonia, and water) that are known to form such biologically important compounds as the amino acids (*2*), sugars (*3*), and adenine (*4, 5*).

The ^{14}C-labeled cyanide, $K^{14}CN$ (15.4

Table 1. Formation of dicyandiamide in "primitive Earth" experiments. UV, ultraviolet; e^-, electron irradiation.

Energy source	Radioactivity		
	Total (μc)	Non-volatile (%)	Dicyandiamide* (%)
1 ml of 7.5 × 10^{-5}M H ^{14}CN			
UV	10	7.3	1.9
1 ml of 7.5 × 10^{-5}M NH_4 ^{14}CN and 1.8 × 10^{-3}M NH_3			
UV	10	3.2	3.5
$^{14}CH_4$, NH_3, H_2O			
e^- beam	500	2.4	0.02
e^- beam	500	1.2	0.002

* There was no detectable cyanamide monomer produced in these experiments. However, the monomer is known to dimerize readily in both acidic and basic solutions (*9*).