

continental rocks originate either deep within the crust or in the mantle beneath the continents in a region in which the Rb/Sr ratio approximates that of basalt, and the isotopic composition of strontium is inhomogeneous but tends to be more radiogenic than in the source region of oceanic basalts (8).

Appendix

Historic and Recent Volcanic Rocks

1. Vesicular basalt, 4 Dec. 1959 eruption of Iki-12, Hawaiian Islands, H. A. Powers, No. G-2811.
2. Vesicular basalt, 11 Nov. 1959 eruption of Iki-1, Hawaiian Islands, H. A. Powers, No. G-2807.
3. Vesicular basalt, 29 Nov. 1959 eruption of Iki-10, Hawaiian Islands, H. A. Powers, No. G-2810.
4. Vesicular basalt, 1924 lava from southwest side of Askja volcano, Iceland, G. T. Faust, No. I-8.
5. Porphyritic, vesicular basalt, 1724-1730 flow near Lake Myvatn, Iceland, G. T. Faust, No. I-12.
6. Pyroxene andesite, 1946 eruption of Sakurajima, Japan, R. A. Bailey.
7. Basaltic cinder, 1886 eruption of Tarawera, New Zealand, R. A. Bailey.
8. Pyroxene andesite, 1886 eruption of Mt. Etna, Sicily, R. L. Smith.
9. Leucite tephrite, 1944 eruption of Vesuvius, Italy, R. L. Smith.
10. Gray vesicular glass, Little Glass Mountain, Medicine Lake, Modoc County, California, H. A. Powers, No. 52-P-123.
11. Obsidian, as above, B. R. Doe.
12. Gray basalt, Highway flow from North Crater, Craters of the Moon, Idaho, H. A. Powers, No. 62-P-81.
13. Gray basalt, Indian Tunnel flow from Big Crater, Craters of the Moon, Idaho, H. A. Powers, No. 62-P-119.
14. Vesicular basalt, Kana-A flow, Sunset Crater, Arizona. Tree-ring date sets eruption at 1066, D. E. Livingston, University of Arizona.
15. Vesicular basalt, Capulin, New Mexico, H. A. Powers, No. 54-P-153.
16. Porphyritic basalt, junction of Eagle and Colorado rivers, Dotsero, Colorado, H. A. Powers, No. 54-P-152.

Sea Water and Limestones

17. Seawater, Gulf Stream, Atlantic Ocean, J. L. Harris.
18. Mollusk shell, modern, Rehoboth Beach, Delaware.
19. Very pure marine limestone, Eocene, Haiti, S. S. Goldich, No. HLC-6.
20. Clean limestone from the Ellenburger Group, Llano County, Texas, Lower Ordovician, S. S. Goldich, No. MH-21-5-445.
21. Marble, Balmat, New York, pre-Grenville, B. R. Doe, No. fd 7-3.
22. Dark-gray carbonaceous Bulawayan Limestone, Southern Rhodesia, Lamont Geological Observatory, No. R-9.

Pleistocene or Older Mafic Rocks

23. Olivine basalt, Sawmill Canyon, Mt. Pinehot quadrangle, California, Pleistocene, G. B. Dalrymple, No. 509-49-5, University of California, Berkeley.
24. Basalt flow, Yellowstone Park, Wyoming, Pliocene, B. R. Doe, No. YP-51-71.
25. Standard diabase W-1, Centerville, Virginia, Triassic.
26. Light-gray basalt or andesite, Franciscan of west-central California, R. W. Kistler, No. D-323.
27. Coarsely crystalline, gray-green anorthosite, Silver Bay, Minnesota, S. S. Goldich.
28. Diabase dike, Sierra Ancha Mountains, Gila County, Arizona, P. E. Damon, No. PED-29-61, University of Arizona.
29. Basalt dike, Granite Falls, Minnesota, S. S. Goldich.
30. Ely Greenstone, Tower, Minnesota, S. S. Goldich.
31. Gray-green anorthosite, Bad Vermilion Lake, Ontario, S. S. Goldich, No. RL-33-58 G.

Pre-Pleistocene Felsic Rocks

32. Obsidian, Los Posos, Jemez Mountains, New Mexico, R. L. Smith.
33. Rhyolite, Cougar Creek, Yellowstone Park, Wyoming, Pliocene, F. R. Boyd, Geophysical Laboratory, Washington, D.C.
34. Snoqualmie Granodiorite, Washington, Tertiary, B. R. Doe.
35. Fine-grained quartz monzonite, Eldora, Colorado, S. R. Hart, Department of Terrestrial Magnetism, Carnegie Institution of Washington.
36. Coarse-grained, gray granite, Clinton quadrangle, Massachusetts, three whole-rock samples, Richard Goldsmith.
37. Coarse-grained, pink granite, Gila County, Arizona, four whole-rock samples, D. E. Livingston, University of Arizona.
38. Gray, coarsely crystalline granite gneiss from a core, Rocky Mountain Arsenal, Denver, Colorado, R. B. Taylor.
39. Medium-grained gray granite, St. Kevin quadrangle, Colorado, seven whole-rock samples, R. C. Pearson.
40. Rhyolite, Gila County, Arizona, five whole-rock samples, D. E. Livingston, University of Arizona.
41. Augen gneiss, Little Belt Mountains, Montana, E. J. Catanzaro, No. 263.
42. Gray to pink, medium-grained granites, Rainy Lake, Ontario, six whole-rock samples, S. S. Goldich.
43. Medium-grained, gray to red granites, vicinity of Sacred Heart, Minnesota, three whole-rock samples, S. S. Goldich.
44. Ortonville granite, three whole-rock samples, vicinity of Ortonville, Minnesota, S. S. Goldich.

45. Banded red and gray quartz monzonite gneiss, nine whole-rock samples, along Minnesota River in vicinity of Morton, Minnesota, S. S. Goldich.

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8. We are indebted to S. S. Goldich, U.S. Geological Survey, and W. R. Shields, National Bureau of Standards, and to numerous colleagues with the Geological Survey who supplied the samples which made this study possible. Additional samples provided by other laboratories are acknowledged in the Appendix. Publication of this paper authorized by the director, U.S. Geological Survey.

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Ethylene Production in Fading Vanda Orchid Blossoms

Abstract. *The production of ethylene by fading blooms of Vanda Miss Agnes Joaquim, determined quantitatively by the perchlorate manometric procedure, was correlated with the degree of fading. A peak production of over 3400 μ l per kilogram hour was obtained when 97 percent of the blooms were faded.*

The blooms of the orchid *Vanda Miss Agnes Joaquim* normally fade in senescence, but premature fading may be induced by subjecting the blossoms to certain gases, by pollination, disturbance, or removal of the pollinia. That ethylene probably causes premature fading was indicated when it was induced by exposure of the blooms to illuminating gas, automobile exhaust fumes, and tobacco smoke, all of which contain ethylene, and by placing *Vanda* blossoms and sections of ripe fruits of various plants that produce ethylene together in an airtight container (1). Exposure of the normal blooms to 1 part per million of ethylene causes them to fade prematurely (2).

From biological assay results (3), the production of ethylene by the blossoms of several species of orchids (for example, *Dendrobium* and *Phalaenopsis* spp.), was determined. Similarly, when fading *Vanda* flowers were sealed with green fruits of various plants, the ripening rate of the fruits was accelerated (1). Young tomato and African marigold plants sealed in a container with fading blooms displayed symptoms of epinasty, a typical ethylene response; carnation blossoms closed prematurely

(an ethylene manifestation commonly called "sleepy" response) in the presence of fading flowers. By biological assay, it was possible to ascertain that ethylene probably is produced by fading *Vanda* flowers. Since brominated charcoal has been found to be effective in preventing the premature fading of normal *Vanda* flowers in the presence of fading blooms (1), Lindner's suggestion (2) that ethylene produced by the blooms of *Vanda* causes their own

Table 1. Ethylene production in fading *Vanda Miss Agnes Joaquim* blossoms.

After removing pollinia (hr)	Ethylene production (μ l/kg hr)	Degree of fading (%)
0	0	0
12	0	5
15	335.21	30
22	508.26	75
25	1016.53	85
28	1638.43	90
30	2582.02	95
32	3442.15	97
34	3359.00	97
36	2851.24	99*
46	1377.07	100†
49	688.53	100‡

* Slightly glassy perianth. † Glassy perianth, and slimy peduncles. ‡ Very glassy perianth, slimy and darkened peduncles, and odoriferous.

fading seems to have been correct.

To determine quantitatively the production of ethylene, 12 freshly harvested, normal *Vanda* blossoms (approximately 24 g) were placed in a 500-ml wide-mouth Erlenmeyer flask maintained in a water bath at 25°C. A stream of humidified air was passed through the flask at the rate of 200 ml/min and bubbled into a solution of mercuric perchlorate for the manometric determination of ethylene (4). After an initial 1-hour collection period, the pollinia of the blooms were removed to cause premature fading, and sampling was continued for consecutive 60-minute intervals. The results of a typical test are shown in Table 1. Normal blossoms did not produce ethylene; however, about 15 hours after the pollinia were removed, ethylene was produced in a measurable quantity. The production then rapidly increased up to 32 hours, the time of the peak rate. In general, ethylene production was correlated with the de-

gree of fading; the peak production occurred when 97 percent of the flowers had faded. The unusually high production of ethylene in these blooms is noteworthy, for the observed maximum value of over 3400 $\mu\text{l}/\text{kg hr}$ is approximately 8.5 times greater than the peak production rate in the purple passion fruit, heretofore the highest reported for any plant material (5; 6).

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Individual Antigenic Specificity of Isolated Antibodies

Abstract. *Antisera produced against certain isolated human antibodies showed clear antigenic differences between these antibodies. Individual antigenic specificity was demonstrated for two anti-A antibodies, one anti-dextran, and one anti-levan antibody. Failure to produce specific antisera in other instances appeared to be correlated with a greater heterogeneity of the antibody population used as antigen.*

Numerous studies in the past have failed to show that isolated antibodies possess individual specificity as antigens. This work has been summarized in several reviews (1). However, observations from a number of laboratories have indicated that myeloma proteins and macroglobulins, with many of the characteristics of individual antibodies, do show antigenic specificity (2, 3). Recently, this work has been extended to include "monoclonal" γ -globulins appearing in smaller amounts in certain presumed normal individuals, and to certain antibodies (4). In view of these findings a reinvestigation of the antigenicity of isolated antibodies was undertaken, particularly since new evidence for a close similarity between myeloma proteins and isolated antibodies has arisen from a variety of studies including starch-gel electrophoresis after reduction in the presence of urea (5) and localization of genetic characters (6).

Anti-A antibodies were isolated from

the serum of seven individuals who developed high titers after immunization with hog gastric A substance. Complement and natural anti- γ -globulin factors were removed by heating at 56°C for 30 minutes and absorption with aggregated γ -globulin. Specific precipitates formed at equivalence, with highly purified A substance, were washed and eluted with acetate buffer pH 3.8. After removal of residual precipitate, the supernatant was dialyzed rapidly against phosphate buffer, pH 7.5. These eluates were employed as antigens and were injected into rabbits primarily by the intraperitoneal route with complete Freund's adjuvants. Dextran and levan antibodies were prepared in a similar fashion from specific precipitates formed with the respective antigens. Subject Ka had produced antibodies to A substance, dextran and levan following immunization. Data concerning the antibody levels have been published (7).

Two of the seven anti-A antibodies produced individual, specific antibodies

after injection into rabbits. The results with the antibodies from serum Th are representative. Three of six rabbits injected with Th antibody formed antibodies which still reacted strongly with the antigen after absorption with normal serum or normal γ -globulin. Figure 1 (top) illustrates this result. Antiserum against Th antibody, after absorption with normal serum, failed to react with Fr II γ -globulin, normal and high γ -globulin sera, or with any of seven other isolated anti-A antibodies. Many additional γ -globulins and other isolated antibodies were tested but only the Th antibody showed the specific reaction with the three different antisera to Th antibody.

These antisera to Th antibody also showed the antibody in whole Th serum. Figure 1 (bottom) illustrates an immunoelectrophoresis experiment demonstrating the sharp antibody line with both the absorbed and unabsorbed antiserum. The unabsorbed antiserum showed a strong reaction with 7S γ -globulin of the serum which is seen in the long bifurcated line. Clear identification of the sharp line as the anti-A antibody was obtained in two ways. First, absorption of Th serum with A substance completely removed the line. Second, immunoelectrophoresis experiments of Th serum with the antiserum in one trough and A substance in the other showed that the line with the rabbit antiserum corresponded exactly in position with the line obtained with A substance. Detailed studies of the antigenic character of isolated Th antibody demonstrated that it had the antigenic characteristics of ordinary 7S γ -globulin. Of particular significance was the finding that all the specificity could be precipitated by ordinary antisera to 7S γ -globulin and antisera to the F portion of 7S γ -globulin.

Antisera to five other isolated anti-A antibodies were also studied in detail. Only one of these showed similar individual specificity. This absorbed antiserum to Ka anti-A failed to react with Th anti-A or any other anti-A studied and reacted only with Ka antibody. Two antisera against other anti-A antibodies failed to show specificity despite the formation of extremely high titers of γ -globulin antibodies.

Two antisera to levan antibodies of Ka serum also showed strong individual specificity. These antisera, after absorption with normal serum, reacted only with the levan antibodies from this serum and not with the other antibodies