# Current Comments

## Journal Citation Studies. 38. Earth Sciences Journals: What They Cite and What Cites Them

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In a recent essay, I described *ISI/GeoSciTech* , a newly available online data base that provides comprehensive coverage of the earth sciences and geotechnology.[1] The *ISI/GeoSciTech* package includes *Current Contents®/GeoSciTech* (*CC®/GeoSciTech*) and *GeoSciTech Citation Index™*. These three parts of the *ISI/GeoSciTech* system cover the key journals in geology, oceanography, meteorology, and atmospheric sciences, as well as journals in related earth sciences such as paleontology, metallurgy and mining, petroleum science, ecology and ecotoxicity, and earthquake engineering.

Robert R. Shrock, Massachusetts Institute of Technology, divides the earth sciences into three basic spheres of interest.[2] The solid earth, or lithosphere, is studied by geologists, geochemists, geophysicists, petrologists, mineralogists, paleontologists, and so on. The oceans of the Earth, or hydrosphere, are studied by oceanologists, marine chemists and biologists, and deep-sea engineers, among others. The atmospheric sciences include meteorology, and atmospheric chemistry and physics.

This essay analyzes the important journals in the earth sciences—what they cite and what cites them. In order to decide which journals were to be included in this study, we started with about 360 journals comprehensively indexed in the 1981 *ISI/GeoSciTech*. These are in addition to the more than 3,000 selectively indexed journals. We processed their references to identify the 20 journals most cited by the *ISI/GeoSciTech* data base. The references in these journals were then processed to see what journals they most frequently cited. This procedure was repeated in four stages until we arrived at a manageable number of journals to examine in detail. Table 1 lists the 81 "core" earth sciences journals included in this study, and the year that each began publication.

We'll treat these core journals as if they were a single "General Journal of the Earth Sciences" to see what it cites, and vice versa. We'll also list the most-cited articles from the core earth sciences journals. That is, we'll examine the literature *of* the earth sciences, as well as the literature *of interest to* earth scientists. Data reported in this study are taken from the *Journal Citation Reports®* (*JCR™*) volume of the 1981 *Science Citation Index®* (*SCI®*).

The core journals listed in Table 1 represent a spectrum of earth sciences fields: geosciences, geology, meteorology, atmospheric sciences, oceanography, mineralogy, metallurgy and mining, water resources, and environmental science. The ten oldest journals, all first published in the 1800s, are in geology, meteorology, and mineralogy: *American Journal of Science*, a geology journal, 1818; *Bulletin de la Société Géologique de France*, 1830; *Journal of the*

**Table 1:** Core earth sciences journals indexed by *ISI/GeoSciTech*™ and *SCI*™, and the year that each began publication.

AAPG Bulletin—American Association of Petroleum Geologists—1917
Acta Metallurgica—1953
American Journal of Science—1818
American Mineralogist—1916
Annales de Geophysique—1945
Annual Review of Earth and Planetary Sciences—1973
Atmospheric Environment—1967
Boundary-Layer Meteorology—1970
Bulletin de la Societe Geologique de France—1830
Bulletin of the American Meteorological Society—1920
Bulletin of the Earthquake Research Institute—University of Tokyo—1926
Bulletin of the Seismological Society of America—1911
Bulletin Volcanologique—1942
Canadian Journal of Earth Sciences—1964
Canadian Mineralogist—1957
Chemical Geology—1966
Clays and Clay Minerals—1968
Contributions to Mineralogy and Petrology—1947
Deep-Sea Research Part A—Oceanographic Research Papers—1953
Earth and Planetary Science Letters—1965
Earth-Science Reviews—1966
Economic Geology—1906
Estuarine Coastal and Shelf Science—1973
Geochimica et Cosmochimica Acta—1950
Geological Magazine—1864
Geological Society of America Bulletin—1888
Geological Society of America Memoirs—1934
Geologische Rundschau—1910
Geology—1973
Geomagnetizm i Aeronomiya—1961
Geophysical Journal of the Royal Astronomical Society—1958
Geophysical Prospecting—1953
Geophysical Research Letters—1974
Geophysics—1936
Icarus—1962
Initial Reports of the Deep Sea Drilling Project—1969
Izvestiya Akademii Nauk SSSR Seriya Geologicheskaya—1936
Journal of the Air Pollution Control Association—1951
Journal of Applied Meteorology—1962
Journal of the Atmospheric Sciences—1944
Journal of Atmospheric and Terrestrial Physics—1950
Journal of Environmental Quality—1972
Journal of the Geological Society—1845
Journal of the Geological Society of Australia—1953
Journal of Geology—1893
Journal of Geomagnetism and Geoelectricity—1949
Journal of Geophysical Research—1949
Journal of Geophysics—Zeitschrift fur Geophysik—1924
Journal of Glaciology—1947
Journal of Marine Research—1937
Journal of the Meteorological Society of Japan—1882
Journal of Petrology—1960
Journal of Physical Oceanography—1971
Journal of Physics of the Earth—1952
Journal of Sedimentary Petrology—1931
Journal of Soil Science—1949
Journal of Volcanology and Geothermal Research—1976
Limnology and Oceanography—1956
Lithos—1968
Marine Geology—1964
Meteoritics—1955
Mineralogical Magazine—1876
Monthly Weather Review—1872
Moon and the Planets—1969
New Zealand Journal of Geology and Geophysics—1958
Physics and Chemistry of the Earth—1956
Physics of the Earth and Planetary Interiors—1967
Planetary and Space Science—1959
Precambrian Research—1974
Pure and Applied Geophysics—1939
Quarterly Journal of the Royal Meteorological Society—1871
Quaternary Research—1970
Reviews of Geophysics and Space Physics—1963
Schweizerische Mineralogische und Petrographische Mitteilungen—1921
Sedimentology—1952
Soil Science—1916
Soil Science Society of America Journal—1936
Space Science Reviews—1962
Tectonophysics—1964
Tellus—1949
Water Resources Research—1965

*Geological Society*, 1845; *Geological Magazine*, 1864; *Quarterly Journal of the Royal Meteorological Society*, 1871; *Monthly Weather Review*, 1872; *Mineralogical Magazine*, 1876; *Journal of the Meteorological Society of Japan*, 1882; *Geological Society of America Bulletin*, 1888; and *Journal of Geology*, 1893. Half of these journals are published by geological and meteorological societies established in the nineteenth century in the US, UK, France, and Japan. This gives us some idea of the age and internationality of the earth sciences.

The core earth sciences journals published about 8,200 source articles in 1981. This represents two percent of the 360,350 research articles included in the

**Table 2:** The 13 most-cited core earth sciences journals, and the number of citations they received, 1981 *JCR*™.

| Journal | Number of Citations |
|---|---|
| J. Geophys. Res. | 23,326 |
| Geochim. Cosmochim. Acta | 6,254 |
| Earth Planet. Sci. Lett. | 5,418 |
| Geol. Soc. Amer. Bull. | 5,329 |
| J. Atmos. Sci. | 5,274 |
| Acta Met. | 4,993 |
| Limnol. Oceanogr. | 4,944 |
| Soil Sci. Soc. Amer. J. | 4,054 |
| Geophys. J. Roy. Astron. Soc. | 3,673 |
| Geophys. Res. Lett. | 3,462 |
| Amer. Mineral. | 3,363 |
| Contrib. Mineral. Petrol. | 3,220 |
| Amer. J. Sci. | 3,145 |

1981 *JCR*. The core journals cited about 215,000 references that year, or three percent of the 7,200,000 references processed in *JCR*. The average earth sciences article, therefore, cited 26 references in 1981. This is among the highest in all scientific fields. Neuroscience articles also cite an average of 26 references.[3] But the average number of references per source item in all journals covered in *JCR* in 1981 was 20.

Articles in core earth sciences journals received nearly 150,000 citations in 1981, or two percent of *JCR* citations that year. Fifty percent of these citations were received by only 13 core journals. They are listed in Table 2, and the number of citations they received from all journals is also shown for each. These 13 journals also published 39 percent of all papers in the earth sciences core in 1981. Thus, earth sciences journals follow the rule of the concentration effect, which I've previously discussed.[4]

Table 3 shows the 50 journals most frequently cited *by* the core group in 1981. They are ranked by the number of citations received from the core journals. The table also lists the number of citations from *all* journals (column B), each journal's self-citations (column C), impact factors (column G), immediacy indexes (column H), and the number of source items each journal published in 1981 (column I). Impact is a measure of the number of citations a journal received in the past few years. Immediacy indicates how often a journal's articles were cited in the same year they were published.

The journals listed in Table 3 received 98,000 citations from the core earth sciences journals. This amounts to 46 percent of all references cited by the core group in 1981. Forty journals are themselves members of the core, and they are indicated by asterisks in Table 3. About two-thirds of the citations these 40 journals received in 1981 came from core earth sciences journals. The journal with the highest percentage of its overall citations from core journals is *Bulletin of the Seismological Society of America*. Eighty-six percent of the 2,445 citations it received in 1981 were from core earth sciences journals.

The ten non-core journals in Table 3 are: *Nature*, *Science*, *Astrophysical Journal*, *EOS Transactions of the American Geophysical Union*, *Philosophical Transactions of the Royal Society of London Series A—Mathematical and Physical Sciences*, *Geological Society of America Abstracts*, *Journal of Fluid Mechanics*, *Journal of Chemical Physics*, *Radio Science*, and *Proceedings of the Royal Society of London Series A—Mathematical and Physical Sciences*.

The core journal with the highest impact—*Meteoritics*—does not appear in Table 3. It received 371 citations from the core group in 1981, 192 short of the 563 core citations required to appear in the table. *Meteoritics* had an impact of 3.92. *Journal of Petrology* ranked second in impact, at 3.31, followed by *Annual Review of Earth and Planetary Sciences* at 2.87. The first three journals in Table 3 ranked fourth, fifth, and sixth, respectively, *Journal of Geophysical Research*, 2.76; *Journal of the Atmospheric Sciences*, 2.63; and *Geochimica et Cosmochimica Acta*, 2.61. *Geophysical Re-*

**Table 3:** The 50 journals most cited *by* core earth sciences journals in 1981. An asterisk indicates a core journal. A = citations received from core journals. B = citations received from all journals. C = self-citations. D = percent of citations from all journals that are core journal citations (A/B). E = percent of citations from all journals that are self-citations (self-cited rate, C/B). F = percent of core citations that are self-citations (C/A). G = impact factor. H = immediacy index. I = 1981 source items.

| | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|
| *J. Geophys. Res. | 18339 | 23326 | 8962 | 78.6 | 38.4 | 48.9 | 2.76 | .92 | 1169 |
| *J. Atmos. Sci. | 4139 | 5274 | 1539 | 78.5 | 29.2 | 37.2 | 2.63 | .60 | 196 |
| *Geochim. Cosmochim. Acta | 3847 | 6254 | 1220 | 61.5 | 19.5 | 31.7 | 2.61 | .49 | 204 |
| *Earth Planet. Sci. Lett. | 3844 | 5418 | 819 | 70.9 | 15.1 | 21.3 | 2.50 | .37 | 209 |
| Nature | 3734 | 99062 | — | 3.8 | — | — | 7.19 | 1.80 | 1402 |
| *Geol. Soc. Amer. Bull. | 3725 | 5329 | 294 | 69.9 | 5.5 | 7.9 | 1.28 | .23 | 101 |
| Science | 3504 | 64355 | — | 5.4 | — | — | 6.24 | 1.33 | 1077 |
| *Geophys. J. Roy. Astron. Soc. | 3020 | 3673 | 859 | 82.2 | 23.4 | 28.4 | 1.91 | .57 | 173 |
| *Geophys. Res. Lett. | 2696 | 3462 | 346 | 77.9 | 10.0 | 12.8 | 2.61 | .42 | 335 |
| *Contrib. Mineral. Petrol. | 2589 | 3220 | 518 | 80.4 | 16.1 | 20.0 | 2.15 | .13 | 107 |
| *Amer. J. Sci. | 2115 | 3145 | 237 | 67.2 | 7.5 | 11.2 | 1.95 | .87 | 55 |
| *Bull. Seismol. Soc. Amer. | 2106 | 2445 | 811 | 86.1 | 33.2 | 38.5 | 1.59 | .39 | 122 |
| *Mon. Weather Rev. | 2105 | 2493 | 1015 | 84.4 | 40.7 | 48.2 | 1.42 | .58 | 209 |
| *Planet. Space Sci. | 1997 | 2550 | 371 | 78.3 | 14.5 | 18.6 | 1.67 | .48 | 134 |
| Astrophys. J. | 1949 | 39176 | — | 5.0 | — | — | 4.04 | 1.05 | 1252 |
| *Amer. Mineral. | 1776 | 3363 | 476 | 52.8 | 14.2 | 26.8 | 1.19 | .21 | 125 |
| *Tectonophysics | 1741 | 2304 | 539 | 75.6 | 23.4 | 31.0 | 1.39 | .34 | 173 |
| *Atmos. Environ. | 1626 | 2608 | 1175 | 62.3 | 45.1 | 72.3 | 1.85 | .66 | 280 |
| *J. Atmos. Terr. Phys. | 1591 | 1994 | 602 | 79.8 | 30.2 | 37.8 | 1.10 | .32 | 139 |
| *Soil Sci. Soc. Amer. J. | 1552 | 4054 | 802 | 38.3 | 19.8 | 51.7 | .97 | .24 | 202 |
| *Can. J. Earth Sci. | 1525 | 1997 | 548 | 76.4 | 27.4 | 35.9 | 1.24 | .19 | 161 |
| *AAPG Bull.—Amer. Ass. Petrol. G. | 1474 | 2014 | 510 | 73.2 | 25.3 | 34.6 | 1.39 | .13 | 141 |
| *J. Appl. Meteorol. | 1391 | 2003 | 426 | 69.4 | 21.3 | 30.6 | .94 | .22 | 140 |
| *J. Sediment. Petrol. | 1389 | 2092 | 495 | 66.4 | 23.7 | 35.6 | 1.03 | .14 | 127 |
| *Icarus | 1387 | 2137 | 629 | 64.9 | 29.4 | 45.3 | 1.62 | .44 | 145 |
| *Rev. Geophys. Space Phys. | 1372 | 1956 | 51 | 70.1 | 2.6 | 3.7 | 2.14 | .44 | 34 |
| *Econ. Geol. | 1340 | 1912 | 804 | 70.1 | 42.1 | 60.0 | .91 | 1.10 | 109 |
| EOS Trans. Amer. Geophys. Un. | 1321 | 1871 | — | 70.6 | — | — | — | — | — |
| *J. Geol. | 1246 | 1960 | 64 | 63.6 | 3.3 | 5.1 | 1.46 | .36 | 47 |
| *Quart. J. Roy. Meteorol. Soc. | 1231 | 1846 | 221 | 66.7 | 12.0 | 18.0 | 1.85 | .32 | 62 |
| *Limnol. Oceanogr. | 1193 | 4944 | 438 | 24.1 | 8.9 | 36.7 | 2.49 | .41 | 116 |
| *J. Phys. Oceanogr. | 1166 | 1651 | 522 | 70.6 | 31.6 | 44.8 | 1.77 | .36 | 129 |
| *Deep-Sea Res. Pt. A—Oceanog. Res. | 1150 | 2229 | 334 | 51.6 | 15.0 | 29.0 | 1.55 | .37 | 99 |
| *J. Petrol. | 1086 | 1348 | 118 | 80.6 | 8.8 | 10.9 | 3.31 | .29 | 17 |
| *Geology | 1012 | 1430 | 121 | 70.8 | 8.5 | 12.0 | 1.90 | .26 | 109 |
| *Geophysics | 986 | 1386 | 436 | 71.1 | 31.5 | 44.2 | 1.09 | .39 | 116 |
| *Tellus | 878 | 1336 | 82 | 65.7 | 6.1 | 9.3 | 1.03 | .25 | 56 |
| *Water Resour. Res. | 857 | 2032 | 620 | 42.2 | 30.5 | 72.3 | 1.06 | .29 | 199 |
| *Initial Rep. Deep Sea Drill. Pr. | 826 | 1334 | — | 61.9 | — | — | .38 | — | — |
| Phil. Trans. Roy. Soc. London A | 787 | 2538 | — | 31.0 | — | — | 1.25 | .14 | 212 |
| *Phys. Earth Planet. Interiors | 765 | 1032 | 228 | 74.1 | 22.1 | 29.8 | 1.06 | .48 | 119 |
| Geol. Soc. Amer. Abstr. | 758 | 930 | — | 81.5 | — | — | — | — | — |
| J. Fluid Mech. | 747 | 6598 | — | 11.3 | — | — | 1.61 | .34 | 290 |
| *Acta Met. | 737 | 4993 | 700 | 14.8 | 14.0 | 95.0 | 1.87 | .36 | 183 |
| *Space Sci. Rev. | 664 | 1092 | 68 | 60.8 | 6.2 | 10.2 | 1.99 | .50 | 122 |
| J. Chem. Phys. | 642 | 69594 | — | 0.9 | — | — | 3.03 | .69 | 1800 |
| *Soil Sci. | 627 | 2452 | 178 | 25.6 | 7.3 | 28.4 | .68 | .25 | 113 |
| Radio Sci. | 585 | 1357 | — | 43.1 | — | — | .98 | .31 | 161 |
| *Mar. Geol. | 566 | 865 | 202 | 65.4 | 23.4 | 35.7 | .92 | .33 | 105 |
| Proc. Roy. Soc. London Ser. A | 563 | 11430 | — | 4.9 | — | — | 1.59 | .47 | 159 |

*search Letters* also had an impact of 2.61.

We've begun to reexamine the way we calculate impact factors. In this study, impact is determined by dividing the number of articles a journal published in 1979 and 1980 into the number of citations they received in 1981. Higher impact factors might be derived by using a different two-year base—say, 1978 and 1979 or 1977 and 1978 data. In a future essay, I'll discuss how impact is affected by using different base time periods.

*Economic Geology* ranked first on immediacy, at 1.10, followed by the *Journal of Geophysical Research* at .92; *American Journal of Science* at .87; *Atmospheric Environment*, .66; *Meteoritics*, .65; *Journal of the Atmospheric Sciences*, .60; *Monthly Weather Review*, .58; *Geophysical Journal of the Royal Astronomical Society*, .57; and *Space Science Reviews*, .50. Immediacy is calculated by dividing the number of articles a journal published in 1981 into the number of citations they received that year.

Table 4 lists 50 journals that most frequently cited the core earth sciences journals. They cited the core group 94,000 times in 1981, accounting for 63 percent of all citations received by the core that year. The five journals that most frequently cited the core group are also the top five journals most cited *by* the core in Table 3: *Journal of Geophysical Research*, *Earth and Planetary Science Letters*, *Geochimica et Cosmochimica Acta*, *Nature*, and *Journal of the Atmospheric Sciences*.

Forty-three of the journals in Table 4 are core earth sciences journals. They are indicated by asterisks. The seven *non*-core journals are: *Nature*; *Science*; *Philosophical Transactions of the Royal Society of London Series A—Mathematical and Physical Sciences*; *Geokhimiya*; *Bulletin de Minéralogie*; *Journal of Volcanology and Geothermal Research*; and *Palaeogeography, Palaeoclimatology, Palaeoecology*. About 13 percent of the references in these seven journals in 1981 are citations to the core earth sciences journals. In contrast, 48 percent of the 1981 references in the 43 core journals in Table 4 were to the core group.

Table 5 lists the most-cited articles from the core earth sciences journals in this study. Also shown are the number of citations each paper received from 1961 to 1980 in *SCI*, and the number of "classic" papers each journal published. Only those journals that produced at least one paper cited more than 50 times from 1961 to 1980 are shown. Seventy-two of the 81 core journals met or exceeded this threshold.

The most-cited paper, by H.S. Yoder and C.E. Tilley, Carnegie Institution, Washington, DC, was published in the *Journal of Petrology* in 1962. It discusses the origin of basalt magma, a type of rock originating miles below the Earth's surface. It erupts to the surface via volcanoes, and is typically found on the seafloor.

The next most-cited paper deals with seafloor spreading along mid-ocean ridges. These ridges form a chain of submerged volcanoes that erupt with basalt magma. The constant eruptions push apart the oceanic crust, forcing the continents to drift and collide with each other. The paper was written by X. Le Pichon, Université de Paris VI (Pierre et Marie Curie), Paris. It was published in the *Journal of Geophysical Research* in 1968. Le Pichon was one of the 1,000 most-cited authors publishing from 1965 to 1978.[5] And the *Journal of Geophysical Research* produced the largest number of articles cited 50 or more times from 1961 to 1980—929. This may be an important indicator of its key place in the literature.

Twenty-one of the 72 articles listed in Table 5 are included as core papers in *ISI/GeoSciTech* research fronts.[6] Table 6 shows the names of the research fronts

**Table 4:** The 50 journals which most frequently cited core earth sciences journals in 1981. An asterisk indicates a core journal. A = citations to core journals. B = citations to all journals. C = self-citations. D = percent of citations to all journals that cite core journals (A/B). E = percent of citations to all journals that are self-citations (self-citing rate, C/B). F = percent of citations to core journals that are self-citations (C/A). G = impact factor. H = immediacy index. I = 1981 source items.

| | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|
| *J. Geophys. Res. | 19769 | 35259 | 8962 | 56.1 | 25.4 | 45.3 | 2.76 | .92 | 1169 |
| *Earth Planet. Sci. Lett. | 3766 | 6988 | 819 | 53.9 | 11.7 | 21.7 | 2.50 | .37 | 209 |
| *Geochim. Cosmochim. Acta | 3646 | 7848 | 1220 | 46.5 | 15.5 | 33.5 | 2.61 | .49 | 204 |
| Nature | 3445 | 35851 | — | 9.6 | — | — | 7.19 | 1.80 | 1402 |
| *J. Atmos. Sci. | 3073 | 4407 | 1539 | 69.7 | 34.9 | 50.1 | 2.63 | .60 | 196 |
| *Tectonophysics | 2936 | 6308 | 539 | 46.5 | 8.5 | 18.4 | 1.39 | .34 | 173 |
| *Contrib. Mineral. Petrol. | 2686 | 4415 | 518 | 60.8 | 11.7 | 19.3 | 2.15 | .13 | 107 |
| *Geophys. J. Roy. Astron. Soc. | 2647 | 4503 | 859 | 58.8 | 19.1 | 32.5 | 1.91 | .57 | 173 |
| *Geophys. Res. Lett. | 2455 | 4842 | 346 | 50.7 | 7.1 | 14.1 | 2.61 | .42 | 335 |
| *Mon. Weather Rev. | 2357 | 3743 | 1015 | 63.0 | 27.1 | 43.1 | 1.42 | .58 | 209 |
| *J. Atmos. Terr. Phys. | 2063 | 3112 | 602 | 66.3 | 19.3 | 29.2 | 1.10 | .32 | 139 |
| *Atmos. Environ. | 2017 | 5702 | 1175 | 35.4 | 20.6 | 58.3 | 1.85 | .66 | 280 |
| *Can. J. Earth Sci. | 1950 | 4982 | 548 | 39.1 | 11.0 | 28.1 | 1.24 | .19 | 161 |
| Science | 1797 | 27203 | — | 6.6 | — | — | 6.24 | 1.33 | 1077 |
| *Planet. Space Sci. | 1737 | 3063 | 371 | 56.7 | 12.1 | 21.4 | 1.67 | .48 | 134 |
| *Econ. Geol. | 1727 | 4206 | 804 | 41.1 | 19.1 | 46.6 | .91 | 1.10 | 109 |
| Phil. Trans. Roy. Soc. London A | 1715 | 7210 | — | 23.8 | — | — | 1.25 | .14 | 212 |
| *Bull. Seismol. Soc. Amer. | 1654 | 2823 | 811 | 58.6 | 28.7 | 49.0 | 1.59 | .39 | 122 |
| *J. Sediment. Petrol. | 1571 | 3628 | 495 | 43.3 | 13.6 | 31.5 | 1.03 | .14 | 127 |
| *Phys. Earth Planet. Interiors | 1555 | 2893 | 228 | 53.8 | 7.9 | 14.7 | 1.06 | .48 | 119 |
| *Rev. Geophys. Space Phys. | 1503 | 3535 | 51 | 42.5 | 1.4 | 3.4 | 2.14 | .44 | 34 |
| *Amer. Mineral. | 1440 | 3186 | 476 | 45.2 | 14.9 | 33.1 | 1.19 | .21 | 125 |
| *Icarus | 1438 | 3643 | 629 | 39.5 | 17.3 | 43.7 | 1.62 | .44 | 145 |
| *J. Phys. Oceanogr. | 1414 | 2650 | 522 | 53.4 | 19.7 | 36.9 | 1.77 | .36 | 129 |
| *Mar. Geol. | 1359 | 3452 | 202 | 39.4 | 5.9 | 14.9 | .92 | .33 | 105 |
| *Soil Sci. Soc. Amer. J. | 1301 | 3574 | 802 | 36.4 | 22.4 | 61.6 | .97 | .24 | 202 |
| *Geol. Soc. Amer. Bull. | 1237 | 3022 | 294 | 40.9 | 9.7 | 23.8 | 1.28 | .23 | 101 |
| *AAPG Bull.—Amer. Ass. Petrol. G. | 1220 | 3396 | 1378 | 35.9 | 15.0 | 41.8 | 1.39 | .13 | 141 |
| *J. Appl. Meteorol. | 1164 | 2303 | 426 | 50.5 | 18.5 | 36.6 | .94 | .22 | 140 |
| *Geology | 1124 | 2679 | 121 | 42.0 | 4.5 | 10.8 | 1.90 | .26 | 109 |
| *J. Geol. | 1035 | 2114 | 64 | 49.0 | 3.0 | 6.2 | 1.46 | .36 | 47 |
| *Water Resour. Res. | 1014 | 4110 | 620 | 24.7 | 15.1 | 61.1 | 1.06 | .29 | 199 |
| *Amer. J. Sci. | 995 | 2741 | 237 | 36.3 | 8.6 | 23.8 | 1.95 | .87 | 55 |
| *Chem. Geol. | 908 | 2016 | 85 | 45.0 | 4.2 | 9.4 | .93 | .25 | 81 |
| Geokhimiya SSSR | 907 | 3948 | — | 23.0 | — | — | .34 | .10 | 183 |
| *Deep-Sea Res. Pt. A—Oceanog. Res. | 865 | 2309 | 334 | 37.5 | 14.5 | 38.6 | 1.55 | .37 | 99 |
| *Sedimentology | 857 | 2084 | 123 | 41.1 | 5.9 | 14.4 | 1.12 | .21 | 63 |
| *J. Geol. Soc. | 856 | 2062 | 95 | 41.5 | 4.6 | 11.1 | 2.33 | .26 | 61 |
| Bull. Mineral. | 854 | 2169 | — | 39.4 | — | — | .87 | .14 | 108 |
| *Geomagn. Aeron. SSSR | 786 | 2066 | 333 | 38.0 | 16.1 | 42.4 | .27 | .10 | 205 |
| *J. Petrol. | 780 | 1289 | 118 | 60.5 | 9.2 | 15.1 | 3.31 | .29 | 17 |
| J. Volcanol. Geotherm. Res. | 772 | 1638 | 51 | 47.1 | 3.1 | 6.6 | 1.11 | .49 | 57 |
| *Geophysics | 764 | 1648 | 436 | 46.4 | 26.5 | 57.1 | 1.09 | .39 | 116 |
| *Annu. Rev. Earth Planet. Sci. | 746 | 1522 | 12 | 49.0 | 0.8 | 1.6 | 2.87 | .38 | 16 |
| Palaeogeogr. Palaeoclimatol. | 742 | 3028 | — | 24.5 | — | — | .82 | .29 | 63 |
| *Bound.-Lay. Meteorol. | 719 | 1318 | 180 | 54.6 | 13.7 | 25.0 | 1.01 | .19 | 75 |
| *J. Geophys.—Z. Geophys. | 710 | 1317 | 58 | 53.9 | 4.4 | 8.2 | 1.03 | .28 | 51 |
| *Miner. Mag. | 707 | 1573 | 76 | 44.9 | 4.8 | 10.7 | .48 | .11 | 73 |
| *Acta Met. | 706 | 4306 | 700 | 16.4 | 16.3 | 99.2 | 1.87 | .36 | 183 |
| *Precambrian Res. | 695 | 1973 | 71 | 35.2 | 3.6 | 10.2 | .69 | .21 | 44 |

**Table 5:** Most-cited articles from each core earth sciences journal cited 50 or more times, 1961-1980 *SCI®*, in alphabetical order by first author. The overall number of papers receiving 50 or more citations in each journal is shown in parentheses. Code numbers following bibliographic data on the articles indicate the *ISI/GeoSciTech*™ research front that includes the article as a core document.

| Citations 1961-1980 | Bibliographic Data |
|---|---|
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**Table 6:** *ISI/GeoSciTech* ™ research fronts that contain one or more of the core earth sciences journal articles cited 50 or more times as a core document, 1961-1980 *SCI*®, including the name of the article's first author. Numbers in parentheses indicate how many citing articles are included in each research front.

| *ISI/GeoSciTech* research front # | Name |
|---|---|
| 81-0087 (289) | Petrogenesis of igneous and metamorphic rocks (Bence A E) |
| 81-0130 (48) | Seismic importance of the Samail ophiolite of Oman (Reinhardt B M) |
| 81-0170 (596) | Electrodynamic features of the thermosphere and ionosphere (Kohl H) |
| 81-0249 (102) | Formation of the Archean complexes of Southern Africa and elsewhere, and the evolution of the continental crust (Hunter D R) |
| 81-0740 (228) | Kinetics of phase separation by spinodal decomposition in binary mixtures (Cahn J W) |
| 81-0749 (256) | Energy balance models of global climate (Sellers W D) |
| 81-0776 (49) | Formation of low-level jets, diurnal winds, and cyclones over the midwestern USA and elsewhere (Blackadar A K) |
| 81-1204 (111) | Uptake and toxicity of cadmium in plants (Haghiri F) |
| 81-1290 (116) | Baroclinic instability under various flow regimes (Eady E T) |
| 81-1394 (200) | Ozone depletion by halogenated hydrocarbons and nitrous oxide (Crutzen P J) |
| 81-1486 (117) | Geochemistry and isotope systematics of high-grade metamorphic terrains (Lambert I B) |
| 81-1669 (73) | Evolution of turbulence and entraining convection in the planetary boundary layer (Deardorff J W) |
| 81-1827 (107) | Cosmic-ray intensity, diffusion and inter-planetary transport (Hasselmann K) |
| 81-1892 (276) | Pleistocene oceanography and climatic change from isotope and biostratigraphic data (Shackleton N J) |
| 81-2028 (199) | Geochemistry, petrology and tectonic setting of volcanic complexes and metavolcanic complexes (Pearce J A) |
| 81-2394 (65) | Computations of dispersion of surface waves (Haskell N A) |
| 81-2561 (35) | Late Quaternary tephras from New Zealand (Vucetich C G) |
| 81-3005 (52) | Generation and seasonal variation of transient equatorial planetary waves (Matsuno T) |
| 81-3317 (25) | Disorder and polytypism in mica (Smith J V) |
| 81-3518 (49) | Geochemistry of biotite in igneous and metamorphic rocks and other petrologic studies (Wones D R) |

corresponding to the code numbers following bibliographic data on the articles in Table 5. The numbers in parentheses following the code numbers indicate how many citing articles are in each research front. The research fronts give us a clearer idea of the nature of current earth sciences research. The names are derived from the words and phrases used in the titles of articles included in each research front. Readers will be able to get more detailed views of these research fronts when ISI®'s *Atlas of the Earth Sciences* is completed. Experts from appropriate fields will provide encyclopedic "minireviews" of current theories and developments in the earth sciences.

Comparing Tables 3 and 4, we see that 33 core earth sciences journals are on both tables. Thirteen of these appear in the top 20 on both tables: *Atmospheric Environment*, *Bulletin of the Seismological Society of America*, *Contributions to Mineralogy and Petrology*, *Earth and Planetary Science Letters*, *Geochimica et Cosmochimica Acta*, *Geophysical Journal of the Royal Astronomical Society*, *Geophysical Research Letters*, *Journal of the Atmospheric Sciences*, *Journal of Atmospheric and Terrestrial Physics*, *Journal of Geophysical Research*, *Monthly Weather Review*, *Planetary and Space Science*, and *Tectonophysics*. Thus, these journals rank highest of the 81 core earth sciences journals in terms of the number of their references *to* the core group, and the number of citations they received *from* the core.

Six of these journals also ranked among the top 20 on both impact *and* immediacy. They are: *Atmospheric Environment*, *Geochimica et Cosmochimica Acta*, *Geophysical Journal of the Royal Astronomical Society*, *Geophysical Research Letters*, *Journal of the Atmospheric Sciences*, and *Journal of Geophysical Research*.

In future studies, we'll identify the most-cited earth scientists and the most-cited earth sciences articles. This will give us an insight into the research teams and institutions that have the greatest impact in the earth sciences. We'll also locate the research fronts that include these articles and authors to get a better idea of the cognitive content of current earth sciences research.

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