

# Index

- accretion, 61, 88  
Actinides, 4  
Activator, 5–6, 8, 10, 11, 14–15, 18, 39, 96–97,  
103–104, 120, 134, 135, 150  
Aerobe, 128, 151, 152  
ALH 84001, 112  
Anaerobe, 128, 151  
*ANT suite*, 89, 91  
Aouelloul glass, 39, 40  
Apollo 11, 87, 94, 102  
Apollo 16, 87  
Apollo 17, 92, 103  
Astrobiological, 127–152
- Biochemistry, 129  
Bioessential, 128, 138, 151  
Bioessential elements, 128, 138, 151  
Biogenic minerals, 114, 129, 133  
Biogenic Mn(IV), 132  
Biomineralization, 114, 128, 129,  
133, 149  
Biooxide, 131–133, 152  
Bio-sedimentation, 111  
Black shale, 127–152  
Boron, 74, 76  
Breccia, 29, 30–31, 45, 92, 93, 95, 103,  
118, 120
- Carbonado, 67–68, 76  
Carbonatic manganese ore, 128, 151  
Carbon isotope, 127  
Catalyze, 129, 131, 133, 152  
Cathodoluminescence  
  microscopy, 47, 87–106  
  spectroscopy, 17, 87–106  
CCD detectors, 13, 139  
Chemolithoautotrophic, 128, 151  
Clays, 129, 133, 138
- C-line, 76  
Coccolid, 141, 143, 146, 147  
Cold cathode source, 115  
Cosmic dust, 88  
Cretaceous-Tertiary Boundary, 65  
Crystal  
  field, 6–10, 38, 39, 100, 103, 114  
  growth, 2, 73  
  structure, 2, 8, 9, 11, 39, 105  
CVD, 73, 74, 76, 77
- Defect density, 2  
Diaplectic glass, 24, 36, 37, 39, 46, 47, 48,  
50, 100  
D-line, 76
- Earth, 4, 15, 23, 24, 28, 29, 32, 39, 45, 56, 61,  
68, 87, 88, 90, 97, 103, 105, 112, 113,  
127, 129, 134, 135  
ED-XRF, 139, 141, 145, 151  
Electron-hole center, 4, 5, 6, 11, 16  
Electron source, 112, 115, 120  
Elliptical, 141  
Emission, 2–17, 37, 38, 39, 40, 47, 48, 52, 53,  
54, 58, 67, 94, 95, 96, 97, 98, 99, 100,  
101, 102, 103, 104, 105, 113, 114, 115,  
119, 121, 124, 135, 149  
Energy levels, 3, 4, 5, 6, 8, 9, 12,  
14, 104  
Enzymatic pathway, 132  
Excitation, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14,  
15, 16, 40, 75, 76, 134  
Extracellular, 129, 133, 152
- Feitknechtite, 132, 133  
*FETI suite*, 89, 90, 91  
Filamentous, 141, 146, 147, 148

- Geochemical, 111, 112, 127, 128, 130, 131, 139, 150, 151, 152  
 Geochemistry, 129  
 Giant impact event, 88  
 Graphene, 142, 144  
 Graphite, 37, 62, 63, 64, 65, 68, 69, 70, 71, 72, 73, 77  
  
 H3 center, 75, 80  
 H4 center, 75, 80  
 Heavy metals, 5  
 Highland region, 89, 90, 94  
 Hugoniot Elastic Limit (HEL), 23, 25–27  
 Hydrothermal activity, 51, 113  
 Hydrothermal alteration, 51, 54, 57, 113  
  
 ICP-MS, 2, 87  
 Impact  
   diamond, 37, 61–80  
   glass, 30, 31, 39, 40, 92  
   melt, 55, 56, 57, 62, 63, 64, 73, 92  
   melt rocks, 62, 63  
 Impactor, 61  
 Impurity iron, 2, 4, 95  
 Interplanetary dust particles, 61, 62  
 Intracellular, 129  
 IR, 11, 13, 74, 96, 99, 113  
  
 Jurassic, 30, 127, 133, 135, 136, 151  
  
 KREEP, 88, 89, 90, 91, 92, 103, 104  
 Kutnohorite, 134, 135, 149, 150, 151, 152  
  
 Laboratory impact experiment, 68–73  
 Libyan Desert Glass (LDG), 39, 40  
 Low temperature aquatic systems, 127  
 Low temperature aqueous, 129  
 Luminescence  
   bio-, 3  
   cathode-, 3  
   chemo-, 3  
   crystallo-, 3  
   electro-, 3  
   photo-, 3  
   tribo-, 3  
   X-ray, 3  
 Luminescent mineral, 93, 94, 106, 114  
 Luna 16, 87, 93, 94, 95, 97, 102, 105, 106  
 Luna 20, 94, 95, 96, 97, 98, 99, 100, 101  
 Luna 24, 89, 94, 96, 98, 102  
 Lunar rocks, 87–106  
  
 Manganese, 14, 15, 16, 127, 128, 129, 130, 133, 134, 135, 137, 149, 151, 152  
 Manganite, 133, 139, 142, 143  
 Mare region, 89, 90  
 Mariner 9, 112  
 Mars, 105, 111, 112, 113, 114, 115, 119, 123, 124, 134  
 Mars Exploration Rovers, 112, 113  
 Mars Express, 112, 113  
 Mars Global Surveyor, 112  
 Mars Odyssey, 112  
 Mars Pathfinder, 112, 113  
 Mars Reconnaissance Orbiter, 112  
 Martian sediment, 111–124  
 Membrane mount, 115  
 Metamorphic rocks, 34, 37, 38, 52, 102  
 Metasomatic alteration, 52  
 Meteorite  
   Canyon Diablo iron meteorite, 62, 68  
   carbonaceous chondrites, 61  
   ureilite, 61, 62, 65  
 Microbes, 129–130, 133, 134, 141, 149  
 Microbial activity, 127, 128, 133, 134, 151, 152  
 Microbial oxidation model of Mn(II), 131  
 Micro-diamond, 61  
 Microorganisms, 129, 133, 134, 139, 140, 141, 142, 143, 146, 147, 149, 151, 152  
 Minerals  
   albite, 51, 54  
   anhydrite, 1, 8, 114  
   apatite, 1, 8, 15, 16, 17, 18, 19, 32, 47, 90, 91, 92, 93, 104, 105, 113, 114, 120, 140, 145  
   baddeleyite, 31, 91, 92, 93, 103–104  
   biotite, 46, 57  
   calcite, 1, 6, 8, 14, 51, 52, 113, 134, 135, 138, 139, 140, 145, 151  
   cassiterite, 1  
   corundum, 1  
   cristobalite, 90, 91, 92, 93, 101, 102  
   diamond, 1, 24, 37, 61–80  
   dolomite, 1, 135, 149, 150  
   feldspar, 1, 10, 34, 35, 37, 38, 46, 47, 48, 50, 51, 57, 58, 90, 91, 92, 94–101, 102, 105, 106, 113, 138  
   fluorite, 1, 8, 14, 51  
   halite, 1  
   ilmenite, 90, 91  
   magnesite, 1  
   plagioclase, 9, 10, 36, 37, 39, 47, 51, 57, 89, 90, 92, 94, 95–100, 102  
   pyroxene, 37, 46, 89, 90, 92, 94, 100, 106, 112, 120, 122

- quartz, 1, 16, 19, 31, 32, 34, 35, 36, 37, 38, 40, 47, 48, 50, 52, 53, 54, 55, 57, 92, 93, 101, 103, 114, 138
- rhodochrosite, 134, 135, 136, 138, 139, 140, 145, 149, 151
- scheelite, 1, 8, 39, 104
- sphalerite, 1
- tridymite, 90, 91, 92, 93, 101–103
- whitlockite, 91, 92, 93, 104, 105, 106
- zircon, 1, 8, 31, 32, 39, 47, 90, 91, 92, 93, 103–104
- Mn cycling, 129
- Mn deposit, 127, 136, 138
- Mn-oxide proto ore, 128
- N3-center, 74, 75, 76, 77
- Nanodiamond, 62, 65, 71
- Nitrogen, 74, 75, 76, 78, 80
- Non-bridging oxygen hole center (NBOHC), 17, 40, 52, 102
- OMEGA, 71, 113
- Optical microscopy, 139, 146
- Oxidation of Mn(II), 129, 130, 131
- Paramagnetic centers, 16
- Phase transformation, 36, 69, 71, 72
- Phobos 2, 112
- Phonon, 5, 7, 40
- Photon energy, 5
- Phyllomanganate, 131, 132, 133
- PIXE, 2, 87, 94, 98, 117, 135
- Planar Deformations Features (PDFs), 24, 34, 35, 36, 37, 38, 47, 48, 57, 58
- Planar Fractures (PFs), 34, 35, 36
- Planetary
  - body, 61
  - exploration mission, 111
  - science, 23–40, 134
  - surface, 23
- Planetesimal, 61
- Plutonic rocks, 47, 58
- Post impact alteration, 51–52
- Quencher, 11, 15, 16, 18, 47, 135
- Quenching, 8, 10, 11, 12, 15, 16, 17, 19, 32, 40, 134, 150, 151, 152
- Rare Earth Elements (REE), 4, 11, 15, 39, 89, 97, 103, 104, 105, 107, 114, 123, 135
- Sample carrier, 115, 116
- Scanning electron microscopy, 1, 38, 141, 146
- Sedimentary rocks, 32, 111, 135
- Self-quenching, 15, 17, 134, 150, 151, 152
- Self-trapped excitons (STE), 40, 52, 102
- SEM, 1, 13, 15, 38, 48, 66, 78, 93, 94, 104, 106, 139, 149, 151
- Shatter cone, 24, 27, 33–34, 46
- Shocked quartz, 34, 36, 37, 38, 48, 52, 53, 58
- Shock-induced heat, 51
- Shock metamorphism, 23–40, 45, 46, 48–50, 53, 57, 63
- Shock pressure, 23, 24, 25, 35, 36, 38, 45, 51, 61, 69, 71, 72, 74, 104
- SHRIMP, 2, 87
- Stokes shift, 6, 7, 8, 9
- Stratigraphic uplift, 30
- Stromatolite like structures, 134
- Suevite, 30, 45, 50, 52, 53, 54, 56, 57, 62, 63, 64, 65, 72, 73
- Tektite
  - Muong Nong-type, 32, 39, 40
  - strewn field, 32
- Terrestrial impact craters
  - Araguainha, 51, 52
  - Barringer, 28, 29
  - Bosumtwi, 32, 37
  - Charlevoix, 33, 48, 50, 52, 53, 57
  - Chesapeake, 32
  - complex crater, 28–30, 56
  - Dellen, 51
  - Ilyinets, 63
  - Kara, 63, 65
  - Lappajärvi, 51, 64–65, 66, 78, 79, 80
  - Manicouagan, 30
  - Obolon, 63
  - Popigai, 62–63, 65, 68, 69, 73, 78, 79, 80
  - Puchezh-Katunski, 65
  - Ries, 30, 32, 37, 38, 39, 48, 50, 51, 57, 63–64, 65, 72, 73, 78, 79, 80
  - Siljan, 30, 38, 48, 50, 51, 52, 54, 57, 58
  - simple crater, 28–30
  - Sudbury, 65
  - Terny, 63
  - Wabar, 48, 50, 52, 54, 55
  - Zapadnaya, 63
- Thermal quenching, 8, 11, 12, 16, 19
- Todorokite, 133, 134
- Trace elements, 2, 13, 14, 15, 18, 47, 58, 88, 103, 114, 135, 138
- Transition metal ions, 4
- Transmission Electron Microscopy (TEM), 35, 36, 64, 65, 68, 142, 144, 148, 149
- Tubular, 141–142, 143, 146, 148
- Tunguska, 65

- Úrkút, 127–128, 133, 135, 137, 138, 149, 150,  
151, 152
- Viking Landers, 112
- Viking Orbiters, 112
- XRD, 1, 138, 139, 142, 143, 144, 145, 149
- XRD analyses, 139
- Yanis-Järvi, 63