



کانیهای رس

Clay Minerals

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کانیهای رس

۰۲



تعداد واحد: ۲

سوع واحد: ۲ واحد نظری - ۱ واحد عملی

پیشنیاز: ندارد

سرفصل درس:

نظری: تعاریف و مفاهیم - اصول کریستالوگرافی و ساختمان بلوری - کانیهای سیلیکاتی و غیر سیلیکاتی در خاک، انواع سیلیکاتها، سیلیکاتهای اولیه خاکی سولفانها و کربناتها و اکسیدهای فلزی - خصوصیات اصلی کانیهای رس (کانولینیت، اپلیت، ورمیکولیت، اسمکتیت، کلریت کانی های فیبری آلوفان و ایموگولیت) - پراکنش کانیهای رس در خاکهای مختلف - تشریح روشهای مختلف شناسایی رس از جمله پراش اشعه ایکس - آبیگری - میکروسکوپ الکترونیکی و روشهای شیمیایی و حرارتی

عملی: آماده سازی یک نمونه جهت مطالعه بنا روشهای مختلف تشخیص - اشعه ایکس و غیره ... و تفسیر منحنیهای مربوطه.

1.0 Introduction

(Understanding of Soil Minerals)

DEFINITION: A mineral is a naturally occurring homogeneous solid with definite (but not generally fixed) chemical composition and a highly ordered atomic arrangement.

-Mineralogy is the science that studies the minerals in SOIL environment.

- About 3000 minerals are identified in the nature. With mineral phases the number may be 10x more.

- A large number of minerals occur in the same environment that make the studies very difficult. We need to design techniques to isolate or concentrate minerals so that we can understand their behavior.

-50% of soils, physical support, Release of nutrient during weathering, indicators of the amount of weathering.

- Adsorb many organic and inorganic pollutants. Some minerals are themselves pollutants.

- Appreciation of the minerals and the soils is critical to our understanding and use of soils for the betterment of mankind and protection of our fragile environment.

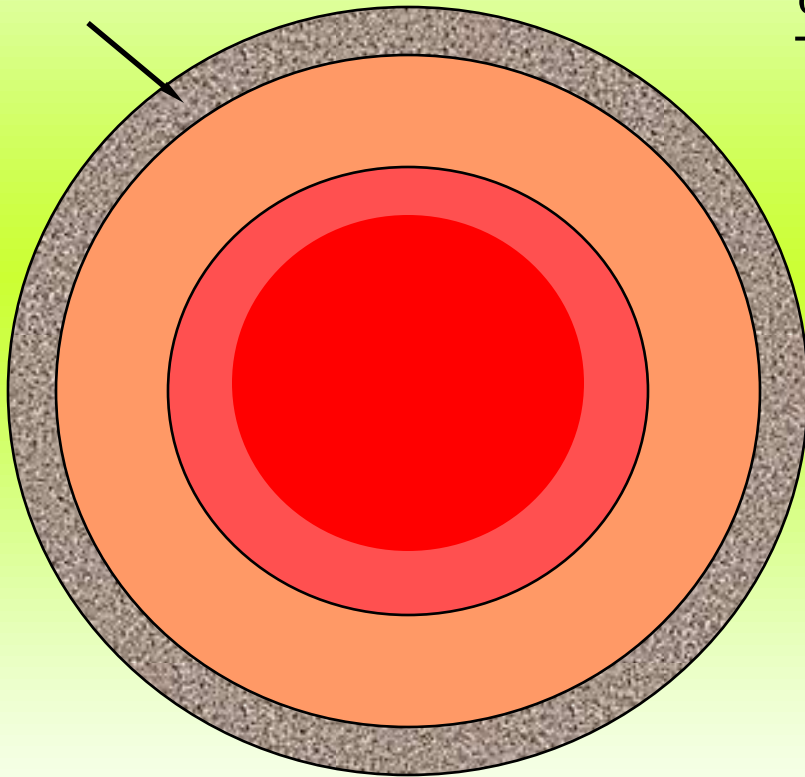
- Scientists from many disciplines (agriculture, civil engineering, sedimentary petrology, economic geology, hydrology, environment, etc.) use this knowledge.

Knowledge of mineralogy

- **To understand why soil properties vary between horizons, pedons, and landscapes.**
- **To know soil processes are occurring and direction of genesis**
- **Management decisions and interpretations are based on dominant minerals or suites of minerals in soils**

Elements of Earth

8-35 km crust



12500 km dia

% by weight in crust

O	= 46.6	}	82.43%
Si	= 27.7		
Al	= 8.13		
Fe	= 5		
Ca	= 3.63		
Na	= 2.83		
K	= 2.59		
Mg	= 2.09		
other	= 1.43		

Table 1-1. The 12 most common chemical elements in the Earth's crust (after Klein & Hurlbut, 1993).

Element	Crustal average	Mole fraction	Ionic radius†	Volume
	g kg ⁻¹		nm	%
O	466.0	0.6057	0.136 (3)	92.88
Si	277.2	0.2052	0.026 (4)	0.22
Al	81.3	0.0626	0.039 (4)	0.23
Fe	50.0	0.0186	0.078 (6)	0.54
Ca	36.3	0.0188	0.100 (6)	1.15
Na	28.3	0.0256	0.102 (6)	1.66
K	25.9	0.0138	0.151 (8)	2.89
Mg	20.9	0.0179	0.072 (6)	0.41
Ti	4.4	0.0019	0.061 (6)	0.03
H	1.4	0.0289	‡	‡
P	1.0	0.0007	0.017 (4)	<0.01
Mn	0.9	0.0003	0.083 (6)	0.01

Table 1-2. Common nonsilicate minerals in soils.

Mineral class	Mineral	Chemical formula†
Halides	Halite	NaCl
Sulfates	Gypsum	CaSO ₄ •2H ₂ O
	Jarosite	KFe ₃ (SO ₄) ₂ (OH) ₆
Sulfides	Pyrite	FeS ₂
Carbonates	Calcite	CaCO ₃
	Dolomite	CaMg(CO ₃) ₂
	Nahcolite	NaHCO ₃
	Trona	Na ₂ CO ₃ •NaHCO ₃ •2H ₂ O
	Soda	Na ₂ CO ₃ •10H ₂ O
Oxides and hydroxides		
Aluminum	Gibbsite	Al(OH) ₃
Iron	Hematite	Fe ₂ O ₃
	Goethite	FeOOH
	Lepidocrocite	FeOOH
	Maghemite	Fe ₂ O ₃
	Ferrihydrite	Fe ₅ O ₇ (OH)•4H ₂ O
	Magnetite	Fe ₃ O ₄
	Birnessite	(Na,Ca,Mn ²⁺) Mn ₇ O ₄ •2.8 H ₂ O
	Lithiophorite	LiAl ₂ Mn ₂ ⁴⁺ Mn ³⁺ O ₆ (OH) ₆
Manganese	Hollandite	Ba(Mn ⁴⁺ ,Mn ³⁺) ₈ O ₁₆
	Todorokite	(Na,Ca,K) _{0.3-0.5} (Mn ⁴⁺ ,Mn ³⁺) ₆ O ₁₂ •3.5H ₂ O
Titanium	Rutile	TiO ₂
	Anatase	TiO ₂
	Ilmenite	Fe ²⁺ TiO ₃

Average amounts of the elements in crustal rocks, in weight percent for the common elements (as indicated by %) in parts per million for the less abundant elements^a.

Atomic Number	Element	Crustal Average	Granite (G-1)	Diabase (W-1)
1	H	0.14%	0.04%	0.06%
3	Li	20	24	12
4	Be	2.8	3	0.8
5	B	10	2	17
6	C	200	200	100
7	N	20	8	14
8	O	46.60%	48.50%	44.90%
9	F	625	700	250
11	Na	2.83%	2.46%	1.54%
12	Mg	2.09%	0.24%	3.99%
13	Al	8.13%	7.43%	7.86%
14	Si	27.72%	33.96%	24.61%
15	P	0.10%	0.04%	0.06%
16	S	260	175	135
17	Cl	130	50	
19	K	2.59%	4.51%	0.53%
20	Ca	3.63%	0.99%	7.83%
21	Sc	22	3	34
22	Ti	0.44%	0.15%	0.64%
23	V	135	16	240
24	Cr	100	22	120
25	Mn	0.09%	0.02%	0.13%
26	Fe	5.00%	1.37%	7.76%
27	Co	25	2.4	50
28	Ni	75	2	78
29	Cu	55	13	110
30	Zn	70	45	82
31	Ga	15	18	16
32	Ge	1.5	1.0	1.6
33	As	1.8	0.8	2.2
34	Se	0.05		
35	Br	2.5	0.5	0.5
37	Rb	90	220	22
38	Sr	375	250	180
39	Y	33	13	25
40	Zr	165	210	100
41	Nb	20	20	10
42	Mo	1.5	7	0.05
44	Ru	0.01		
45	Rh	0.005		
46	Pd	0.01	0.01	0.02
47	Ag	0.07	0.04	0.06

Atomic Number	Element	Crustal Average	Granite (G-1)	Diabase (W-1)
48	Cd	0.2	0.06	0.3
49	In	0.1	0.03	0.08
50	Sn	2	4	3
51	Sb	0.2	0.4	1.1
52	Te	0.01		
53	I	0.5		
55	Cs	3	1.5	1.1
56	Ba	0.04%	0.12%	0.02%
57	La	30	120	30
58	Ce	60	230	30
59	Pr	8.2	20	2
60	Nd	28	55	15
62	Sm	6.0	11	5
63	Eu	1.2	1.0	1.1
64	Gd	5.4	5	4
65	Tb	0.9	1.1	0.6
66	Dy	3.0	2	4
67	Ho	1.2	0.5	1.3
68	Er	2.8	2	3
69	Tm	0.5	0.2	0.3
70	Yb	3.4	1	3
71	Lu	0.5	0.1	0.3
72	Hf	3	5.2	1.5
73	Ta	2	1.6	0.7
74	W	1.5	0.4	0.45
75	Re	0.001	0.0006	0.0004
76	Os	0.005	0.001	0.004
77	Ir	0.001	0.006	
78	Pt	0.01	0.008	0.009
79	Au	0.004	0.002	0.005
80	Hg	0.08	0.2	0.2
81	Tl	0.5	1.3	0.13
82	Pb	13	49	8
83	Bi	0.2	0.1	0.2
90	Th	7.2	52	2.4
92	U	1.8	3.7	0.52

^a From Principles of Geochemistry by Brian Mason. 1966, by John Wiley & Sons, Inc.

THE EIGHT MOST COMMON CHEMICAL ELEMENTS IN THE CRUST^a

	Weight Percent	Atom Percent (wt% divided by atomic wt.)	Ionic Radius (Å)	Volume Percent
O	46.60	62.55	1.40	93.77
Si	27.72	21.22	0.42	0.86
Al	8.13	6.47	0.51	0.47
Fe	5.00	1.92	0.74	0.43
Mg	2.09	1.84	0.66	0.29
Ca	3.63	1.94	0.99	1.03
Na	2.83	2.64	0.97	1.32
K	2.59	1.42	1.33	1.83

^a From *Principles of Geochemistry* by Brian Mason. 1966, by John Wiley & Sons, Inc.