

9. BASIC STRUCTURAL FEATURES

Table 9.4.1.7. Atomic distances between oxygen and main-group elements in their special oxidation states

Atom pair	<i>N</i>	Mean	s.u.	<i>d</i> ₁	Smallest 5%	First quartile	Median	Third quartile	<i>d</i> ₂
Tl ⁺ —O ²⁻	101	265.4	12.9	240.0	244.2	254.2	268.6	275.7	286.0
C ²⁺ —O ²⁻	308	110.5	4.5	88.0	102.7	108.8	111.2	112.9	124.0
Sn ²⁺ —O ²⁻	14	201.1	2.3	196.0	196.7	200.2	201.3	202.8	206.0
Pb ²⁺ —O ²⁻	367	233.2	16.1	190.0	208.1	222.5	232.0	244.2	268.0
N ²⁺ —O ²⁻	23	115.3	3.5	108.0	110.3	112.8	114.3	117.6	124.0
N ³⁺ —O ²⁻	166	119.9	5.4	102.0	109.5	116.7	121.5	123.9	130.0
N ⁴⁺ —O ²⁻	5	119.0	0.0	118.0	117.8	118.2	118.8	119.4	120.0
P ⁺ —O ²⁻	12	149.7	2.3	146.0	145.9	148.0	149.2	152.0	154.0
P ³⁺ —O ²⁻	43	149.9	2.1	142.0	146.1	148.7	149.8	151.3	154.0
P ⁴⁺ —O ²⁻	10	151.6	1.0	150.0	149.6	150.3	151.2	152.3	154.0
As ³⁺ —O ²⁻	61	175.1	4.6	164.0	166.1	172.2	175.6	178.4	186.0
Sb ³⁺ —O ²⁻	101	195.7	5.4	184.0	186.4	192.5	195.3	199.6	208.0
Bi ³⁺ —O ²⁻	122	227.0	5.4	216.0	218.0	222.7	227.7	231.1	238.0
S ²⁺ —O ²⁻	9	145.7	2.2	140.0	140.9	144.5	146.5	147.2	148.0
S ⁴⁺ —O ²⁻	110	146.3	5.5	130.0	136.2	142.6	147.1	151.0	154.0
S ⁵⁺ —O ²⁻	38	145.4	2.7	142.0	141.5	143.8	144.9	145.8	156.0
Se ⁴⁺ —O ²⁻	125	166.5	3.1	154.0	160.8	164.9	166.5	168.5	176.0
Te ⁴⁺ —O ²⁻	124	186.4	4.0	174.0	179.3	184.2	185.9	189.1	198.0
Cl ³⁺ —O ²⁻	8	156.2	1.5	154.0	154.2	155.0	156.0	157.3	160.0
Cl ⁵⁺ —O ²⁻	23	145.5	3.9	136.0	139.1	143.2	146.8	148.6	150.0
Br ⁵⁺ —O ²⁻	11	164.5	0.9	162.0	166.0	164.2	164.6	165.3	166.0
Xe ⁶⁺ —O ²⁻	4	172.5	1.9	170.0	170.2	171.0	172.0	174.0	176.0

Table 9.4.1.8. Atomic distances between oxygen and transition elements in their preferred and special oxidation states

Atom pair	<i>N</i>	Mean	s.u.	<i>d</i> ₁	Smallest 5%	First quartile	Median	Third quartile	<i>d</i> ₂
Y ³⁺ —O ²⁻	208	228.7	7.6	212.0	217.4	222.3	228.0	235.5	244.0
Ti ²⁺ —O ²⁻	7	206.4	2.2	202.0	202.7	204.8	206.5	208.2	210.0
Ti ³⁺ —O ²⁻	79	200.4	4.0	188.0	192.0	197.9	201.7	203.1	208.0
Ti ⁴⁺ —O ²⁻	661	188.7	10.2	156.0	169.9	182.2	190.3	196.1	212.0
V ²⁺ —O ²⁻	10	206.6	3.4	202.0	213.8	204.2	205.5	209.0	214.0
V ³⁺ —O ²⁻	112	198.0	3.7	188.0	191.7	196.1	197.7	199.8	210.0
V ⁴⁺ —O ²⁻	93	165.8	8.8	150.0	156.2	159.3	163.3	171.8	190.0
V ⁵⁺ —O ²⁻	328	165.1	8.5	142.0	152.8	160.5	164.2	168.8	196.0
Cr ²⁺ —O ²⁻	13	203.8	2.8	198.0	196.3	201.5	203.7	206.4	208.0
Cr ³⁺ —O ²⁻	215	196.4	4.0	186.0	190.2	194.0	196.3	198.6	208.0
Cr ⁴⁺ —O ²⁻	4	167.5	1.0	166.0	166.1	166.7	167.3	168.0	170.0
Cr ⁵⁺ —O ²⁻	3	169.0	0.0	168.0	164.3	165.5	167.0	168.5	170.0
Cr ⁶⁺ —O ²⁻	164	159.9	5.0	144.0	150.8	157.2	159.6	163.1	172.0
Mn ²⁺ —O ²⁻	507	210.0	10.4	178.0	193.1	204.1	209.8	215.6	240.0
Mn ³⁺ —O ²⁻	151	191.5	6.1	176.0	181.2	187.6	191.1	195.9	208.0
Mn ⁴⁺ —O ²⁻	74	191.5	6.1	180.0	182.9	187.3	190.5	194.6	208.0
Mn ⁷⁺ —O ²⁻	9	158.8	1.6	156.0	154.8	157.1	158.8	159.9	162.0
Fe ²⁺ —O ²⁻	640	203.6	9.3	172.0	187.3	198.5	203.8	209.3	236.0
Fe ³⁺ —O ²⁻	900	192.9	9.1	164.0	176.9	187.4	193.4	198.7	224.0
Co ²⁺ —O ²⁻	263	202.1	7.1	188.0	190.5	196.6	202.6	206.9	222.0
Co ³⁺ —O ²⁻	118	191.8	4.9	176.0	183.9	189.2	191.3	193.9	206.0
Ni ²⁺ —O ²⁻	282	200.3	7.9	176.0	185.1	195.9	202.4	205.3	218.0
Cu ²⁺ —O ²⁻	614	193.5	7.3	164.0	180.7	190.2	193.7	196.5	220.0
Zn ²⁺ —O ²⁻	432	198.1	8.0	182.0	186.7	192.4	196.6	203.2	228.0

9.4. TYPICAL INTERATOMIC DISTANCES: INORGANIC COMPOUNDS

Table 9.4.1.8. Atomic distances between oxygen and transition elements (cont.)

Atom pair	<i>N</i>	Mean	s.u.	<i>d</i> ₁	Smallest 5%	First quartile	Median	Third quartile	<i>d</i> ₂
Sc ³⁺ —O ²⁻	151	205.1	5.2	188.0	196.6	201.6	205.7	208.4	222.0
Zr ⁴⁺ —O ²⁻	268	203.4	7.3	176.0	188.6	201.1	204.4	207.4	222.0
Nb ⁴⁺ —O ²⁻	7	189.9	1.1	188.0	185.9	187.5	189.4	190.8	192.0
Nb ⁵⁺ —O ²⁻	416	186.6	9.4	166.0	171.4	179.1	186.3	194.8	208.0
Mo ³⁺ —O ²⁻	6	207.0	1.8	204.0	200.9	204.5	207.0	208.5	210.0
Mo ⁴⁺ —O ²⁻	34	192.1	5.7	182.0	182.0	185.8	194.8	196.9	200.0
Mo ⁵⁺ —O ²⁻	26	165.8	3.7	158.0	160.3	163.2	165.6	167.6	176.0
Mo ⁶⁺ —O ²⁻	357	171.5	8.3	146.0	158.9	167.6	170.7	174.8	202.0
Tc ⁷⁺ —O ²⁻	4	171.0	0.0	170.0	169.1	169.8	170.5	171.2	172.0
Ru ²⁺ —O ²⁻	3	263.0	0.0	262.0	261.6	262.1	262.7	263.4	264.0
Pd ²⁺ —O ²⁻	31	201.0	2.7	194.0	196.6	199.1	200.9	202.9	208.0
Ag ²⁺ —O ²⁻	6	205.3	2.3	202.0	202.3	203.5	205.0	207.0	210.0
Cd ²⁺ —O ²⁻	276	221.9	10.8	184.0	200.8	217.1	222.5	227.8	254.0
La ³⁺ —O ²⁻	317	244.1	9.2	222.0	230.1	237.7	243.1	249.9	268.0
Hf ⁴⁺ —O ²⁻	11	202.8	1.7	198.0	201.1	202.2	203.0	203.8	206.0
Ta ⁴⁺ —O ²⁻	5	193.0	1.4	190.0	190.5	192.2	193.0	193.8	196.0
Ta ⁵⁺ —O ²⁻	262	191.7	7.6	168.0	177.7	186.5	193.5	196.8	210.0
W ⁵⁺ —O ²⁻	12	189.5	3.1	184.0	179.0	187.0	189.3	192.5	194.0
W ⁶⁺ —O ²⁻	355	180.0	11.3	150.0	161.8	171.8	178.9	190.0	206.0
Re ⁵⁺ —O ²⁻	21	207.5	3.2	202.0	204.0	204.9	206.5	209.5	216.0
Re ⁶⁺ —O ²⁻	3	163.0	0.0	162.0	161.8	162.2	162.8	163.4	164.0
Re ⁷⁺ —O ²⁻	34	175.1	5.3	166.0	168.3	171.2	173.8	178.5	188.0
Os ⁶⁺ —O ²⁻	3	175.0	0.0	174.0	173.6	174.1	174.8	175.4	176.0
Os ⁸⁺ —O ²⁻	12	173.2	2.2	168.0	170.6	172.0	173.2	174.7	178.0
Ir ³⁺ —O ²⁻	5	196.6	1.7	194.0	194.2	195.2	196.5	197.8	200.0
Ir ⁴⁺ —O ²⁻	7	193.9	3.2	190.0	188.3	190.3	193.0	196.5	200.0
Pt ²⁺ —O ²⁻	20	199.3	3.5	192.0	194.0	196.0	200.0	202.0	206.0
Pt ⁴⁺ —O ²⁻	56	201.6	4.5	194.0	193.1	198.9	201.2	203.8	214.0
Au ³⁺ —O ²⁻	9	198.3	1.0	196.0	195.7	197.3	198.5	199.2	200.0
Hg ²⁺ —O ²⁻	94	209.3	11.0	192.0	194.9	202.6	205.7	214.5	236.0

Table 9.4.1.9. Atomic distances between oxygen and lanthanoids

Atom pair	<i>N</i>	Mean	s.u.	<i>d</i> ₁	Smallest 5%	First quartile	Median	Third quartile	<i>d</i> ₂
La ³⁺ —O ²⁻	317	244.1	9.2	222.0	230.1	237.7	243.1	249.9	268.0
Ce ³⁺ —O ²⁻	75	239.2	7.5	220.0	225.5	234.5	238.2	246.1	254.0
Ce ⁴⁺ —O ²⁻	49	234.1	4.9	222.0	224.5	234.0	235.1	236.7	242.0
Pr ³⁺ —O ²⁻	57	239.1	4.8	230.0	232.2	235.7	238.8	241.8	252.0
Nd ³⁺ —O ²⁻	185	235.4	6.4	218.0	224.1	232.0	235.5	239.3	250.0
Sm ³⁺ —O ²⁻	45	228.8	4.2	218.0	221.2	225.5	229.3	232.6	236.0
Eu ³⁺ —O ²⁻	47	231.4	5.4	220.0	222.7	227.2	231.8	235.6	242.0
Gd ³⁺ —O ²⁻	78	228.2	5.7	216.0	219.4	223.9	227.6	231.9	240.0
Tb ³⁺ —O ²⁻	36	229.4	5.7	216.0	218.8	225.0	230.9	233.3	238.0
Dy ³⁺ —O ²⁻	39	226.9	5.6	214.0	216.9	222.5	228.1	231.1	236.0
Ho ³⁺ —O ²⁻	48	227.6	5.4	218.0	220.2	223.3	226.7	231.3	242.0
Er ³⁺ —O ²⁻	69	224.6	5.4	212.0	214.4	220.9	224.6	228.8	236.0
Tm ³⁺ —O ²⁻	24	223.3	4.9	214.0	216.5	220.0	223.3	226.0	234.0
Yb ³⁺ —O ²⁻	78	221.8	4.4	210.0	214.5	218.9	221.4	224.9	234.0
Lu ³⁺ —O ²⁻	35	220.4	7.3	208.0	210.1	213.8	220.5	226.2	234.0