

# Periodic Table of Elements

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18																																								
1	<b>H</b> Hydrogen 1.00794	<table border="1"> <tr> <td>Atomic #</td> <td>Symbol</td> <td>Name</td> <td>Atomic Mass</td> </tr> <tr> <td><b>C</b></td> <td>Solid</td> <td></td> <td></td> </tr> <tr> <td><b>Hg</b></td> <td>Liquid</td> <td></td> <td></td> </tr> <tr> <td><b>H</b></td> <td>Gas</td> <td></td> <td></td> </tr> <tr> <td><b>Rf</b></td> <td>Unknown</td> <td></td> <td></td> </tr> </table>																	Atomic #	Symbol	Name	Atomic Mass	<b>C</b>	Solid			<b>Hg</b>	Liquid			<b>H</b>	Gas			<b>Rf</b>	Unknown			2	<b>He</b> Helium 4.002602																		
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3	<b>Li</b> Lithium 6.941	4	<b>Be</b> Beryllium 9.012182	<table border="1"> <tr> <th colspan="6">Metals</th> <th colspan="6">Nonmetals</th> </tr> <tr> <td>Alkali metals</td> <td>Alkaline earth metals</td> <td>Lanthanoids</td> <td>Transition metals</td> <td>Poor metals</td> <td>Other nonmetals</td> <td>Noble gases</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>												Metals						Nonmetals						Alkali metals	Alkaline earth metals	Lanthanoids	Transition metals	Poor metals	Other nonmetals	Noble gases													5	<b>B</b> Boron 10.811	6	<b>C</b> Carbon 12.0107	7	<b>N</b> Nitrogen 14.0067	8	<b>O</b> Oxygen 15.9994	9	<b>F</b> Fluorine 18.9984032	10	<b>Ne</b> Neon 20.1797
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11	<b>Na</b> Sodium 22.98976928	12	<b>Mg</b> Magnesium 24.3050	13	<b>Al</b> Aluminium 26.9815386	14	<b>Si</b> Silicon 28.0855	15	<b>P</b> Phosphorus 30.973762	16	<b>S</b> Sulfur 32.065	17	<b>Cl</b> Chlorine 35.453	18	<b>Ar</b> Argon 39.948																																											
19	<b>K</b> Potassium 39.0983	20	<b>Ca</b> Calcium 40.078	21	<b>Sc</b> Scandium 44.955912	22	<b>Ti</b> Titanium 47.867	23	<b>V</b> Vanadium 50.9415	24	<b>Cr</b> Chromium 51.9961	25	<b>Mn</b> Manganese 54.938045	26	<b>Fe</b> Iron 55.845	27	<b>Co</b> Cobalt 58.933195	28	<b>Ni</b> Nickel 58.9334	29	<b>Cu</b> Copper 63.546	30	<b>Zn</b> Zinc 65.38	31	<b>Ga</b> Gallium 69.723	32	<b>Ge</b> Germanium 72.64	33	<b>As</b> Arsenic 74.92160	34	<b>Se</b> Selenium 78.96	35	<b>Br</b> Bromine 79.904	36	<b>Kr</b> Krypton 83.798																							
37	<b>Rb</b> Rubidium 85.4678	38	<b>Sr</b> Strontium 87.62	39	<b>Y</b> Yttrium 88.90585	40	<b>Zr</b> Zirconium 91.224	41	<b>Nb</b> Niobium 92.90638	42	<b>Mo</b> Molybdenum 95.96	43	<b>Tc</b> Technetium (97.9072)	44	<b>Ru</b> Ruthenium 101.07	45	<b>Rh</b> Rhodium 102.90550	46	<b>Pd</b> Palladium 106.42	47	<b>Ag</b> Silver 107.8682	48	<b>Cd</b> Cadmium 112.411	49	<b>In</b> Indium 114.818	50	<b>Sn</b> Tin 118.710	51	<b>Sb</b> Antimony 121.760	52	<b>Te</b> Tellurium 127.60	53	<b>I</b> Iodine 126.90447	54	<b>Xe</b> Xenon 131.293																							
55	<b>Cs</b> Caesium 132.9054519	56	<b>Ba</b> Barium 137.327	57-71		72	<b>Hf</b> Hafnium 178.49	73	<b>Ta</b> Tantalum 180.94788	74	<b>W</b> Tungsten 183.84	75	<b>Re</b> Rhenium 186.207	76	<b>Os</b> Osmium 190.23	77	<b>Ir</b> Iridium 192.217	78	<b>Pt</b> Platinum 195.084	79	<b>Au</b> Gold 196.966569	80	<b>Hg</b> Mercury 200.59	81	<b>Tl</b> Thallium 204.3833	82	<b>Pb</b> Lead 207.2	83	<b>Bi</b> Bismuth 208.98040	84	<b>Po</b> Polonium (208.9824)	85	<b>At</b> Astatine (209.9871)	86	<b>Rn</b> Radon (222.0178)																							
87	<b>Fr</b> Francium (223)	88	<b>Ra</b> Radium (226)	89-103		104	<b>Rf</b> Rutherfordium (261)	105	<b>Db</b> Dubnium (262)	106	<b>Sg</b> Seaborgium (266)	107	<b>Bh</b> Bohrium (264)	108	<b>Hs</b> Hassium (277)	109	<b>Mt</b> Meitnerium (268)	110	<b>Ds</b> Darmstadtium (271)	111	<b>Rg</b> Roentgenium (272)	112	<b>Uub</b> Ununbium (285)	113	<b>Uut</b> Ununtrium (284)	114	<b>Uuq</b> Ununquadium (289)	115	<b>Uup</b> Ununpentium (288)	116	<b>Uuh</b> Ununhexium (292)	117	<b>Uus</b> Ununseptium	118	<b>Uuo</b> Ununoctium (294)																							

For elements with no stable isotopes, the mass number of the isotope with the longest half-life is in parentheses.

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57	<b>La</b> Lanthanum 138.90547	58	<b>Ce</b> Cerium 140.116	59	<b>Pr</b> Praseodymium 140.90765	60	<b>Nd</b> Neodymium 144.242	61	<b>Pm</b> Promethium (145)	62	<b>Sm</b> Samarium 150.36	63	<b>Eu</b> Europium 151.964	64	<b>Gd</b> Gadolinium 157.25	65	<b>Tb</b> Terbium 158.92535	66	<b>Dy</b> Dysprosium 162.500	67	<b>Ho</b> Holmium 164.93032	68	<b>Er</b> Erbium 167.259	69	<b>Tm</b> Thulium 168.93421	70	<b>Yb</b> Ytterbium 173.054	71	<b>Lu</b> Lutetium 174.9668
89	<b>Ac</b> Actinium (227)	90	<b>Th</b> Thorium 232.03806	91	<b>Pa</b> Protactinium 231.03688	92	<b>U</b> Uranium 238.02891	93	<b>Np</b> Neptunium (237)	94	<b>Pu</b> Plutonium (244)	95	<b>Am</b> Americium (243)	96	<b>Cm</b> Curium (247)	97	<b>Bk</b> Berkelium (247)	98	<b>Cf</b> Californium (251)	99	<b>Es</b> Einsteinium (252)	100	<b>Fm</b> Fermium (257)	101	<b>Md</b> Mendelevium (258)	102	<b>No</b> Nobelium (259)	103	<b>Lr</b> Lawrencium (262)

# İyonlaşma enerjisi

Bir atomun nötr pozisyonundan bir elektron uzaklaştırmak için gerekli olan enerji (Katyonlaşma enerjisi)

**İyon:** Toplam proton sayısının toplam elektron sayısına eşit olmadığı atom veya molekül. Bu durumda, atom pozitif veya negatif elektron yükü taşır. Bir nötr atom bir veya birden fazla elektron kaybettiğinde, pozitif yüke sahip olur (**katyon**), benzer şekilde, atom elektron alırsa, negatif yüklü olur (**anyon**).



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Düşük İyonlaşma enerjisi

Yüksek İyonlaşma enerjisi



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Azalan İyonlaşma enerjisi

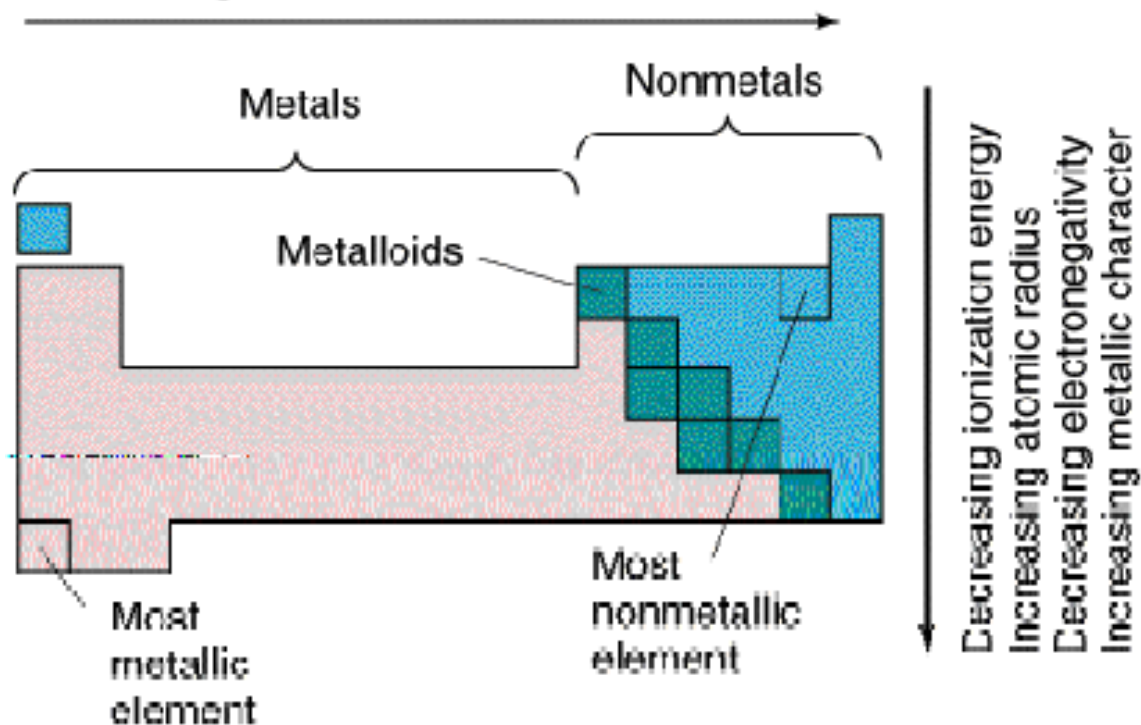
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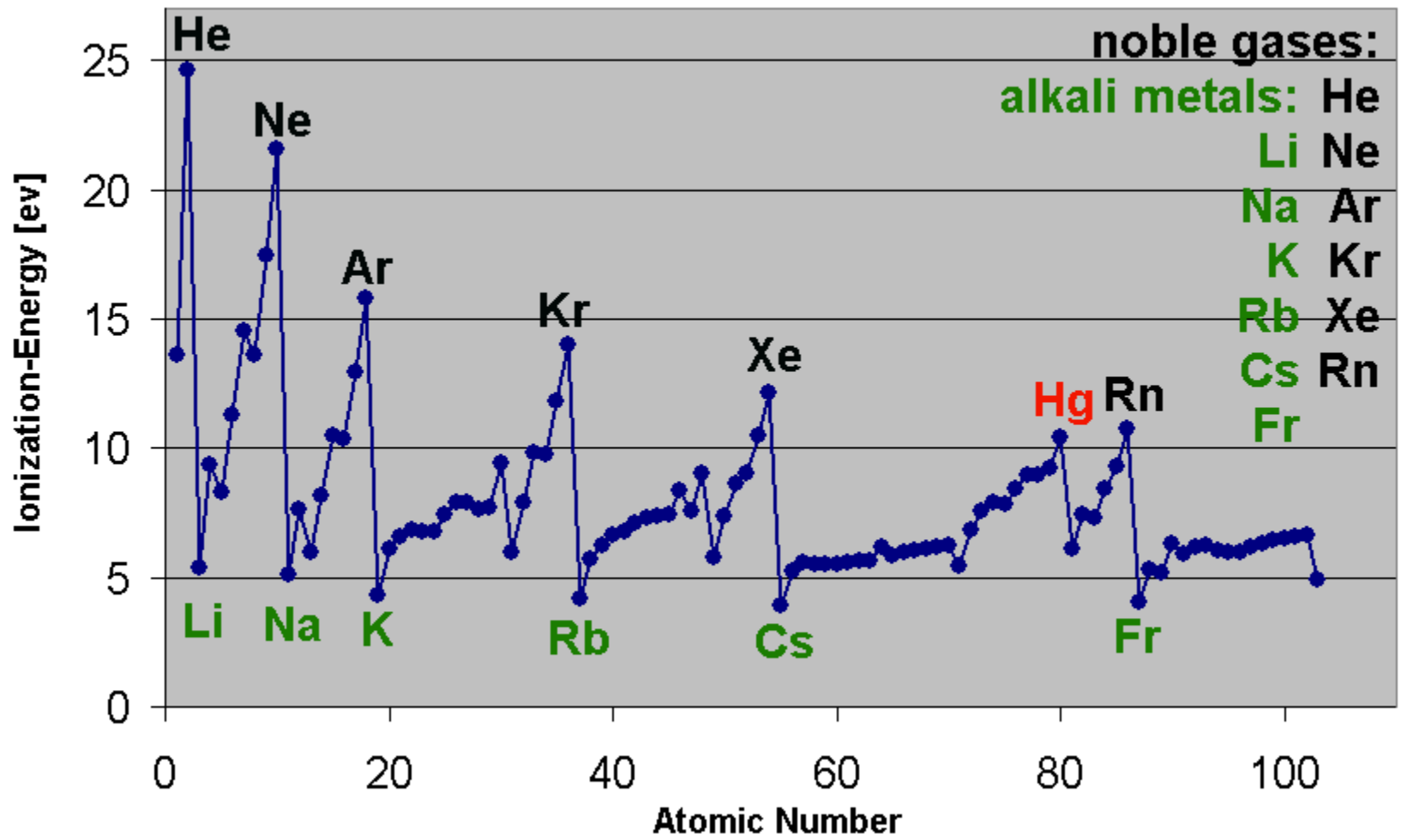


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Increasing ionization energy  
Decreasing atomic radius  
Increasing nonmetallic character and electronegativity  
Decreasing metallic character



# Ionization-Energy



# **ELEMENTLERİN BİRBİRİNİN YERİNE GEÇMESİ**

# İzomorfizma (Eşbiçimlilik)

Benzer kimyasal bileşim ve kristal yapısına sahip maddeler birbirlerinin izomorfudurlar.

Katı eriyik ? (Olivin mineralleri: Fayalit ve forsterit)

Halit ve galen izomorflar...

Fayalit:  $\text{Fe}_2\text{SiO}_4$

Forsterit:  $\text{Mg}_2\text{SiO}_4$

Halit:  $\text{NaCl}$  (1 katyon – 1 anyon)

Galen:  $\text{PbS}$

$(\text{Fe}, \text{Mg})_2\text{SiO}_4$

$(\text{Fe}_{1.83}\text{Mg}_{0.17})\text{SiO}_4$

# Polimorfizma (Çok biçimlilik)

Benzer kimyasal bileşim ancak farklı kristal yapısına sahip maddeler birbirlerinin polimorfudurlar.

Kalsit (trigonal) ve Aragonit (ortorombik) ( $\text{CaCO}_3$ )

Kuvars (trigonal) ve Kalsedon (trigonal-monoklinik) ( $\text{SiO}_2$ )



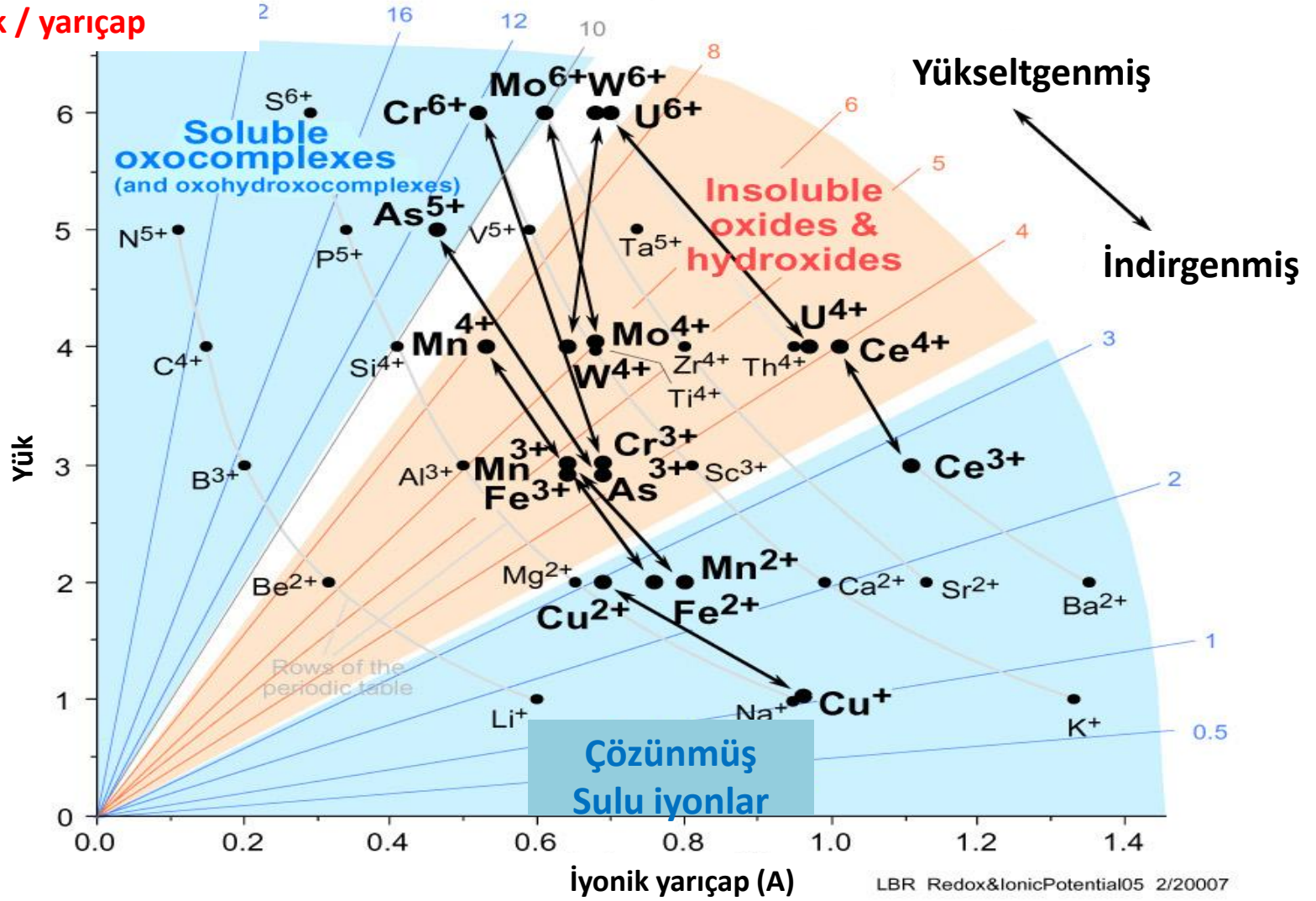
# İyonik Potansiyel

Bazı elementlerin birden fazla pozitif oksitlenme durumu vardır (yani birden çok katyon oluşturabilirler) ve bu katyonların davranışı farklı olmaktadır.

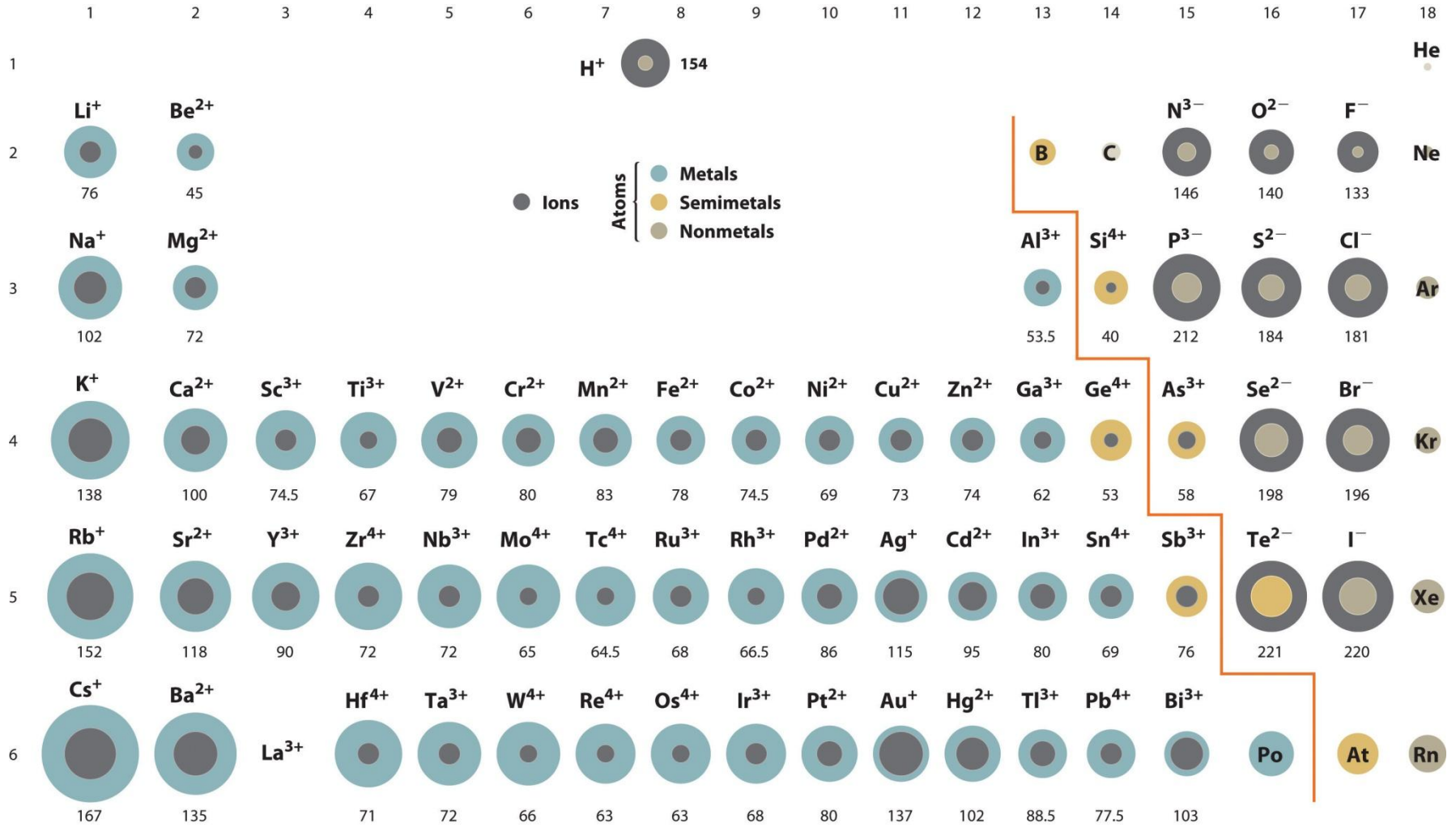
Katyonların çözünürlüğü, iyon yükünün iyon yarıçapına oranı olarak tanımlanan “iyonik potansiyel” kavramına bağlıdır.  $\text{Na}^+$  gibi düşük iyonik potansiyele sahip iyonlar oksijen ile zayıf bağ kurduklarından kolay çözünürler. Bunun yanı sıra,  $\text{S}^{+6}$  gibi yüksek iyonik potansiyele sahip iyonlar oksijen ile çok kuvvetli bağ yaparlar ve  $\text{SO}_4^{-2}$  (sülfat) şeklinde çözünür anyon kompleksleri oluştururlar. Bunların arasında kalan  $\text{Al}^{+3}$  gibi orta derecede iyonik potansiyele sahip iyonlar ise, oksijen ile birleşerek çözünürlüğü oldukça düşük duraylı oksitler veya hidroksitler oluştururlar.

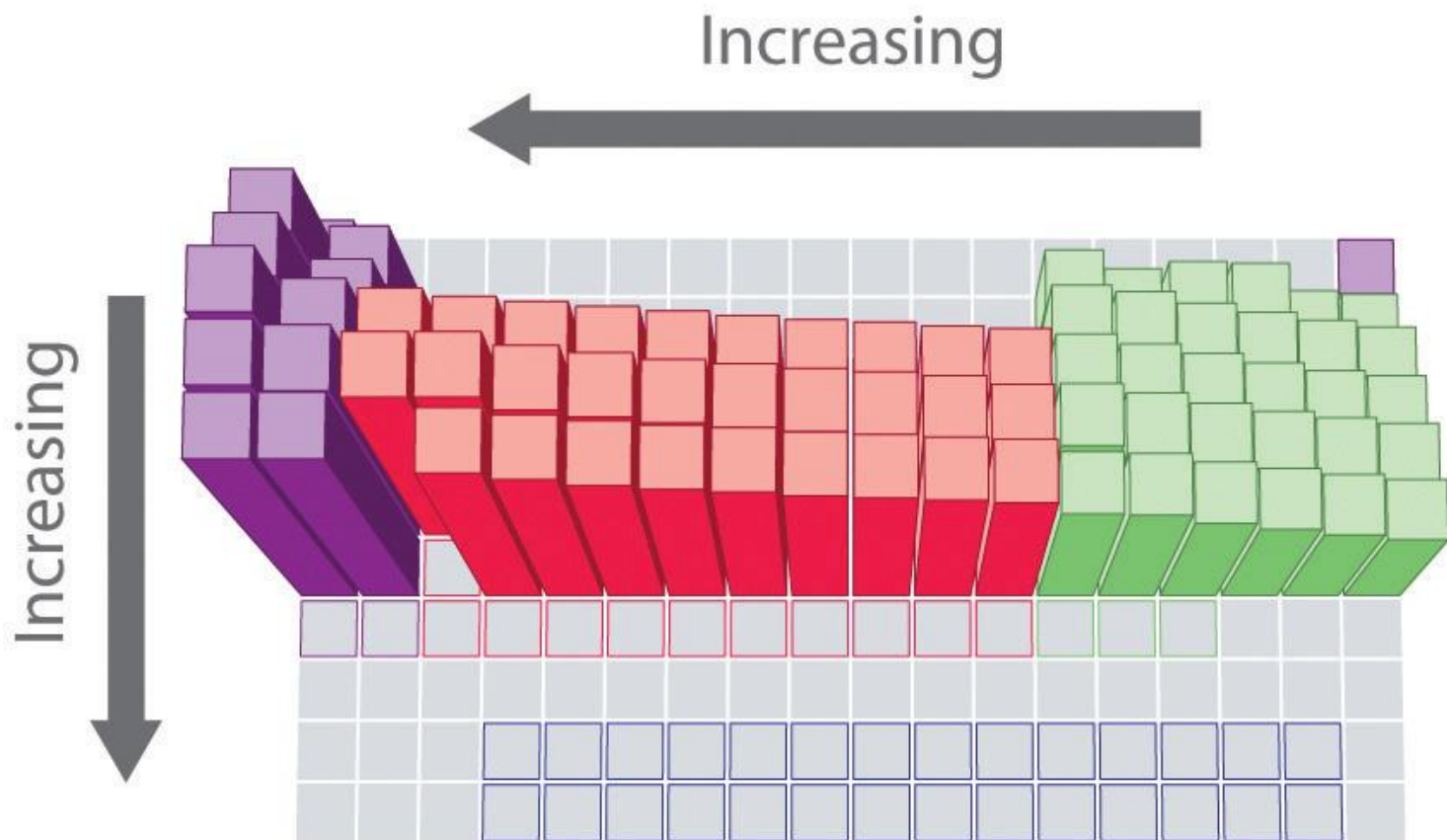
Oksitlenme veya indirgenme bazı elementlerin bir gruptan bir diğerine geçmesine neden olur. Örneğin, Fe indirgenme durumunda  $\text{Ca}^{+2}$  veya  $\text{Mg}^{+2}$  gibi çözünür olmakta, ancak oksitlenme şartlarında ( $\text{Fe}^{+3}$ )  $\text{Al}^{+3}$  gibi çözünürlüğü düşmektedir.

iyonik potansiyel =  
yük / yarıçap



# Elementlerin atom yarıçapları (pikometre olarak) (1 pikometre = 0.01 angström)





Calculated atomic radius (pm),  
*s*-, *p*-, and *d*-block elements

■ *s* block

■ *p* block

■ *d* block

■ *f* block