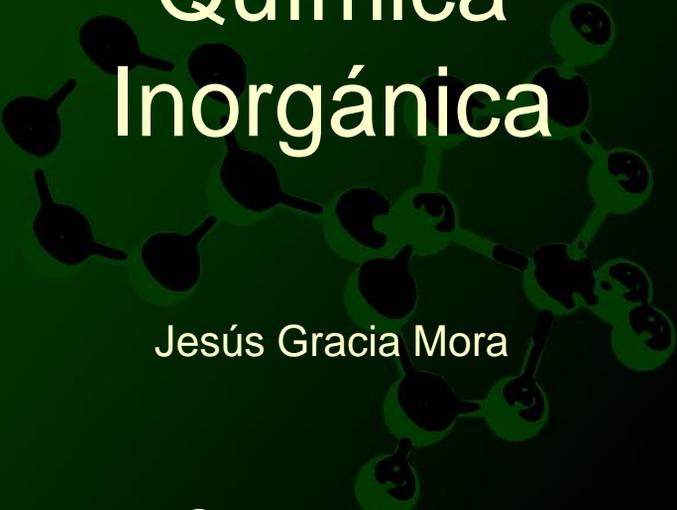


# Química Inorgánica



Jesús Gracia Mora

[jgracia@comunidad.unam.mx](mailto:jgracia@comunidad.unam.mx)

## Temario

### 1. LA TABLA PERIÓDICA

1.1 Origen estelar de los elementos.

1.2 Propiedades periódicas de los átomos enlazados: electronegatividad y radios (covalente, iónico, metálico y de Van der Waals).

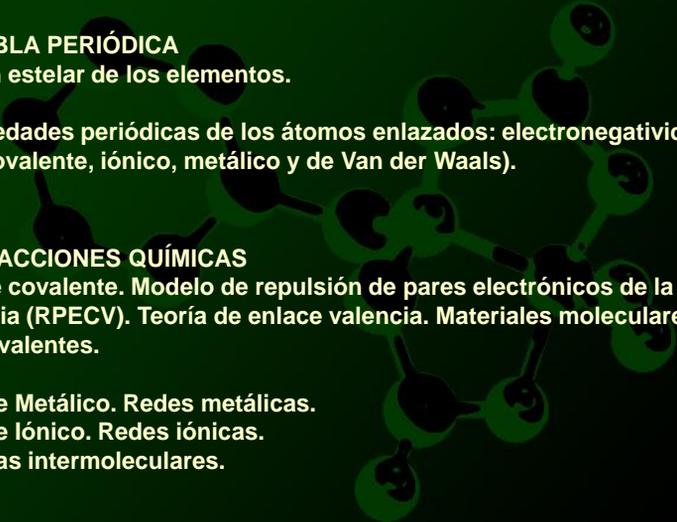
### 2. INTERACCIONES QUÍMICAS

2.1 Enlace covalente. Modelo de repulsión de pares electrónicos de la capa de valencia (RPECV). Teoría de enlace valencia. Materiales moleculares y Redes covalentes.

2.2 Enlace Metálico. Redes metálicas.

2.3 Enlace Iónico. Redes iónicas.

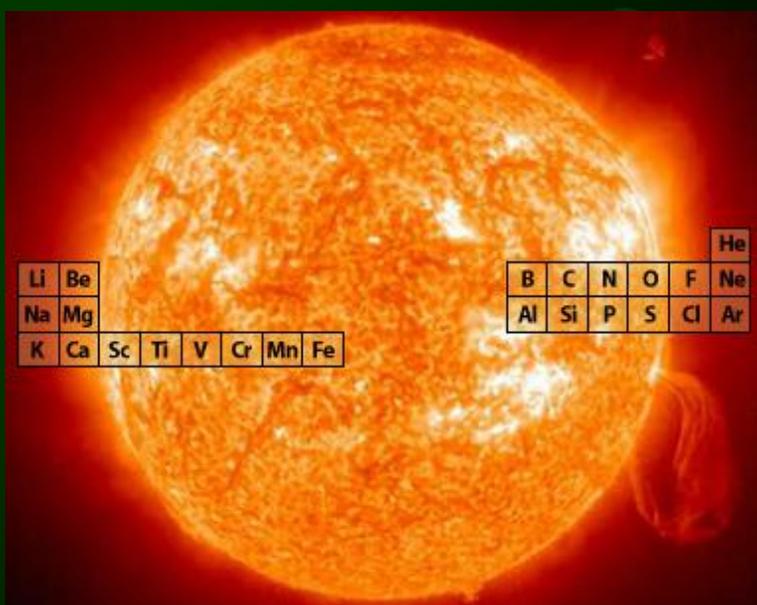
2.4 Fuerzas intermoleculares.



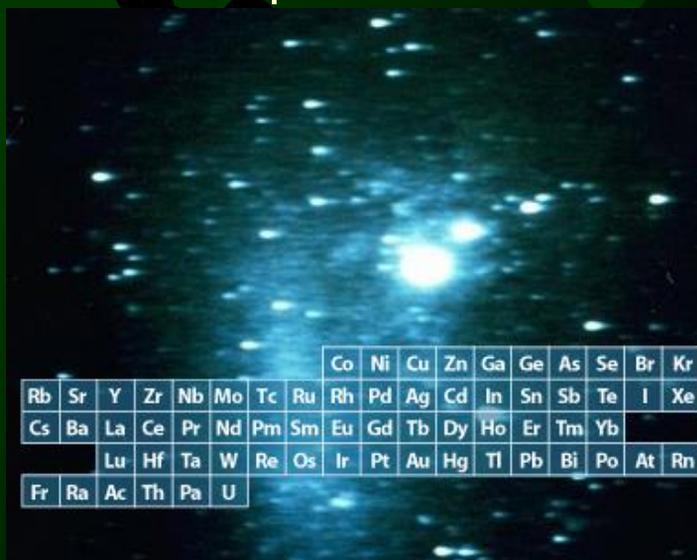
# Origen Estelar de los Elementos

Jesús Gracia Mora

¿Cuándo y en donde se originan los elementos químicos?



## ¿Qué procesos son los más importantes?



## Para contestar preguntas acerca de ....

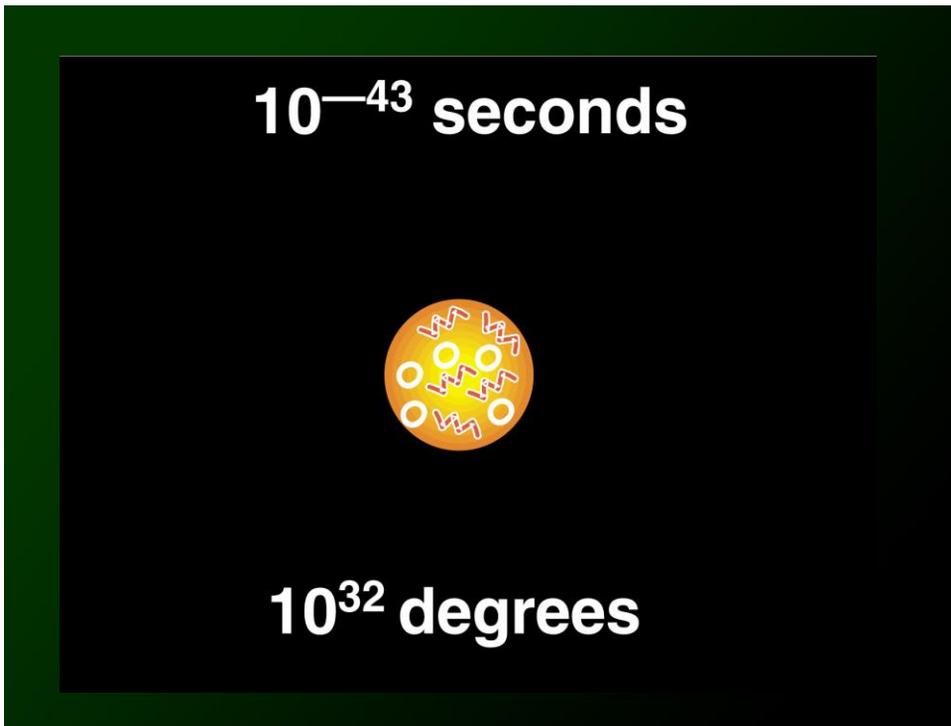
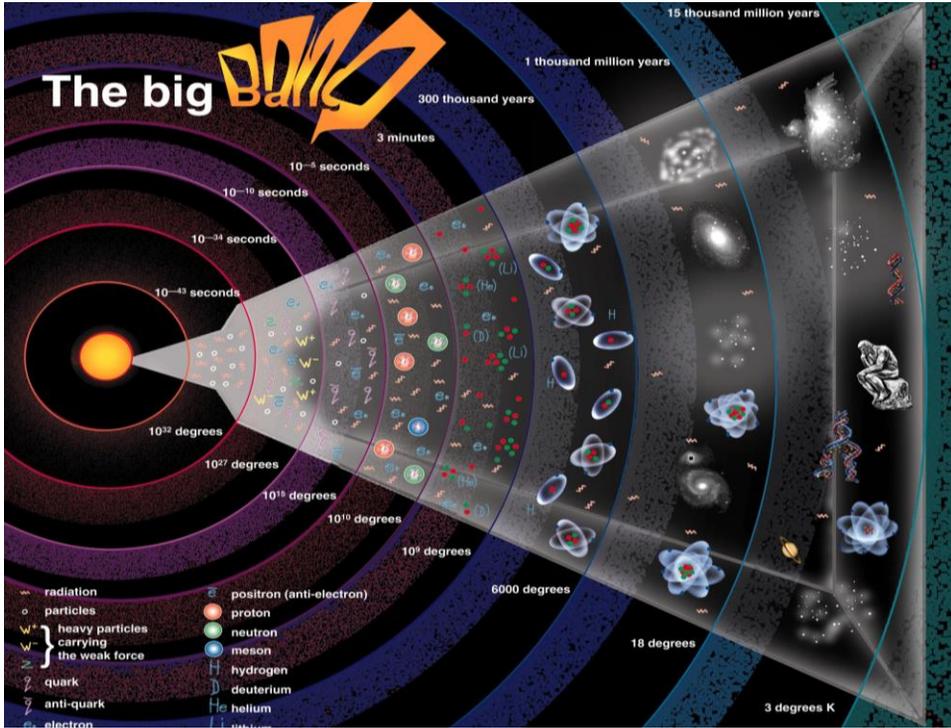
- Origen del Universo
- Origen, vida y muerte de las estrellas
- Procesos dinámicos en el Universo
- Evolución química en el Universo

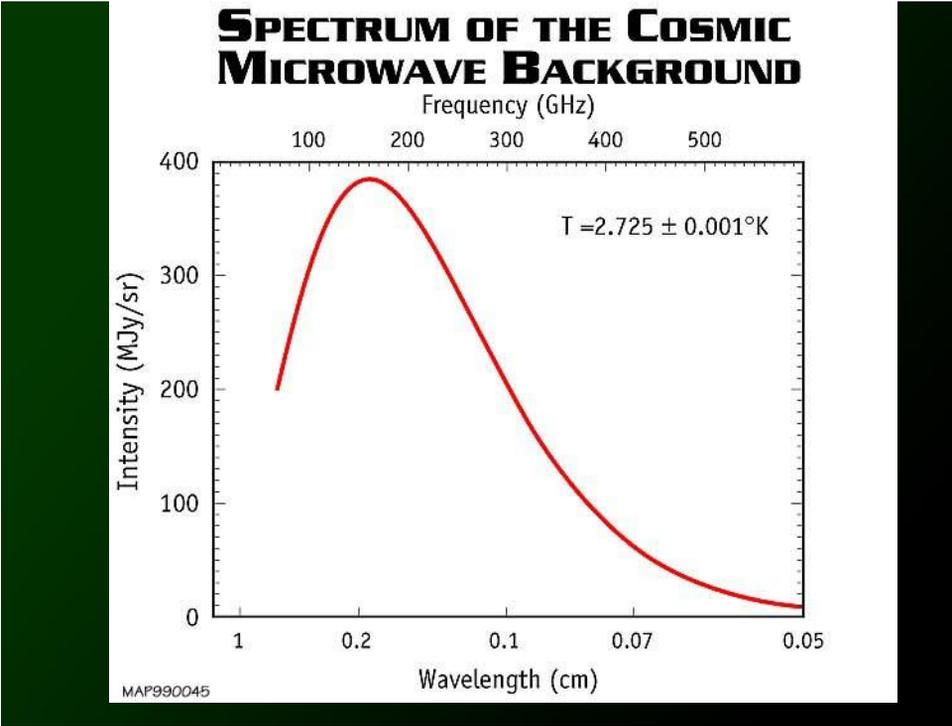
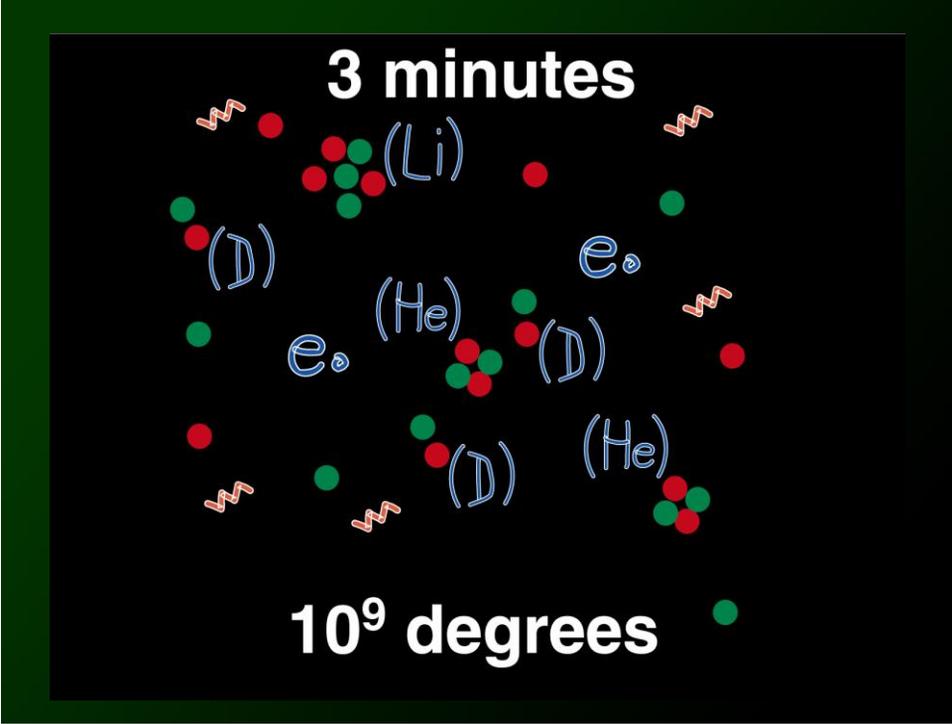
## Teorías del origen del Universo

- La más aceptada el Big-bang
- En Español la GRAN EXPLOSIÓN
  - Evidencia

## Antecedentes

- Radiación electromagnética
- Partículas subatómicas
- ¿Qué es lo que hace diferente a los átomos entre sí?
- Número atómico, masa atómica, etc.

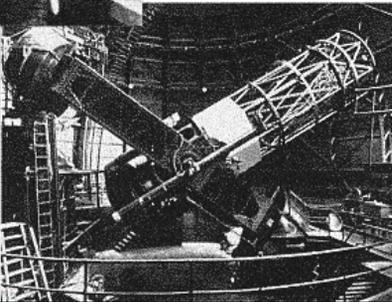
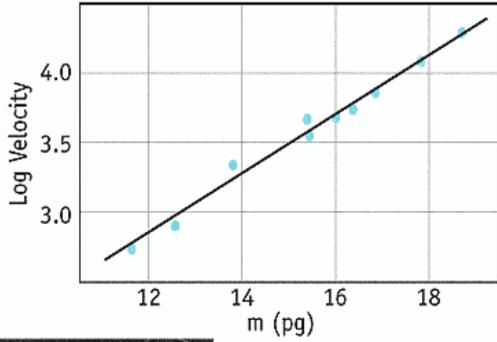




# DISCOVERY OF EXPANDING UNIVERSE

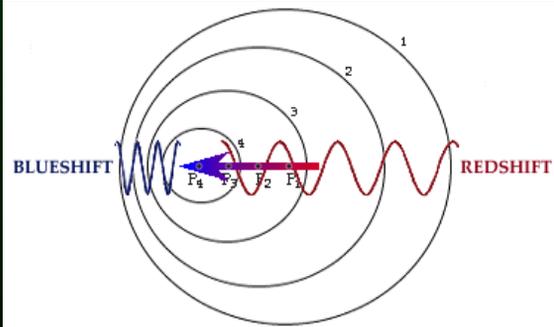
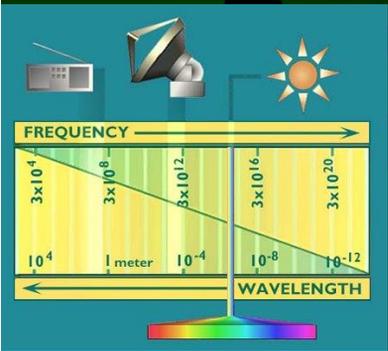


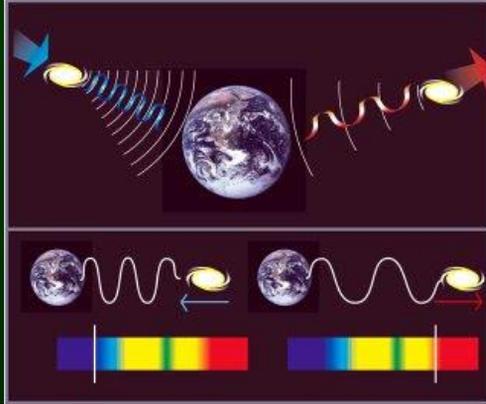
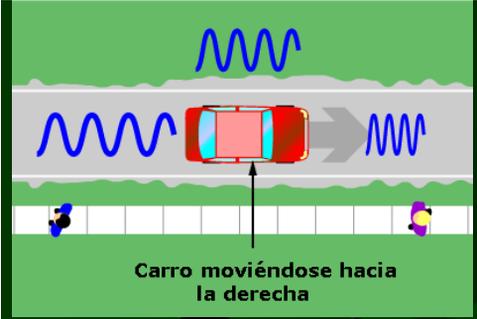
Edwin Hubble



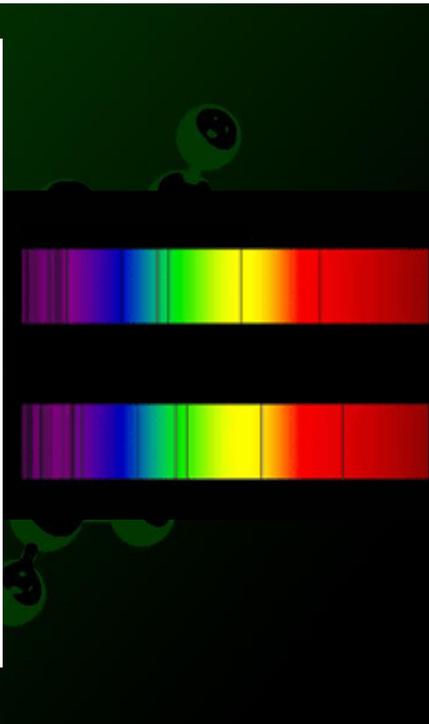
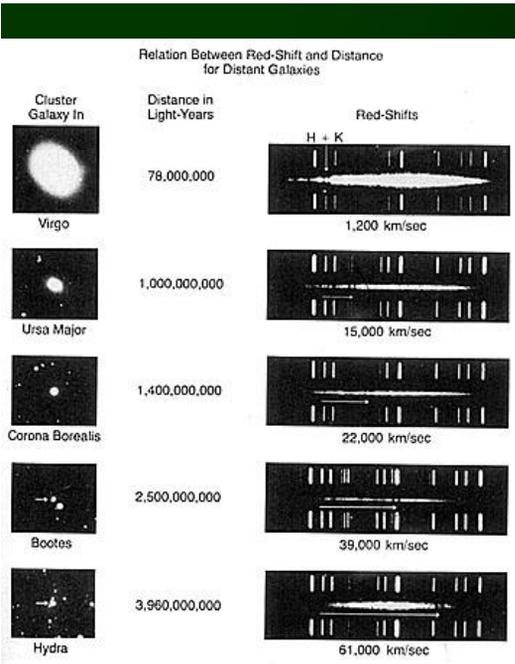
Mt. Wilson  
100 Inch  
Telescope

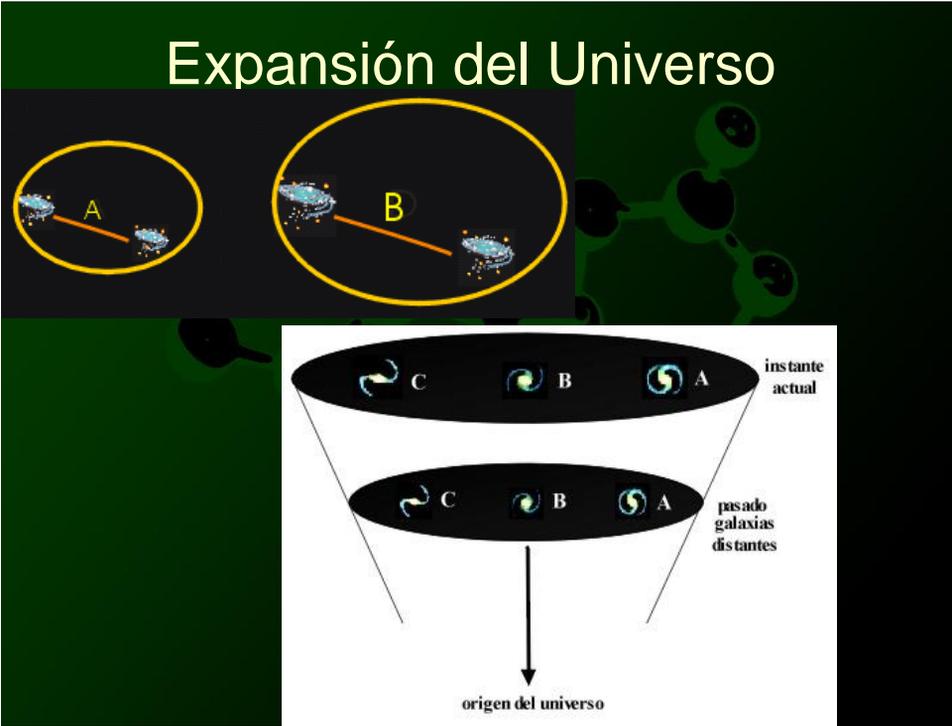
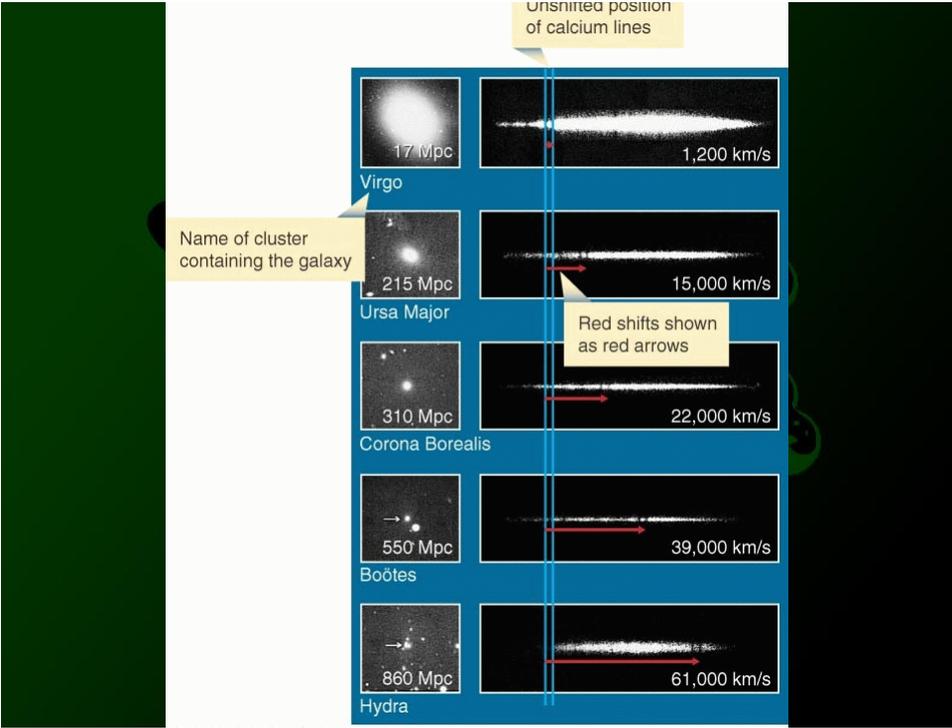
# Efecto Doppler





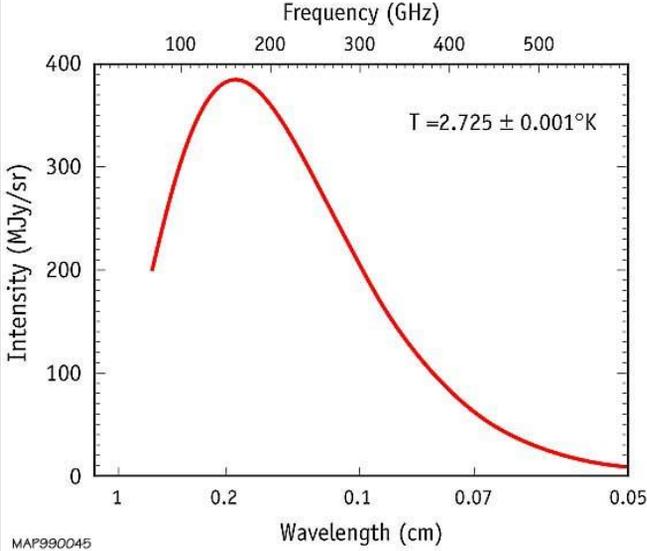
Efecto Doppler



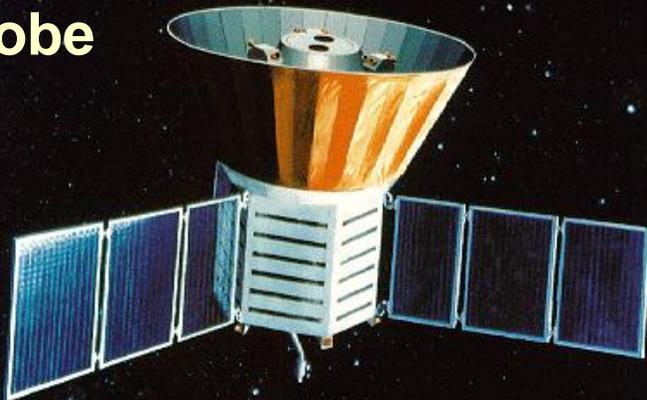


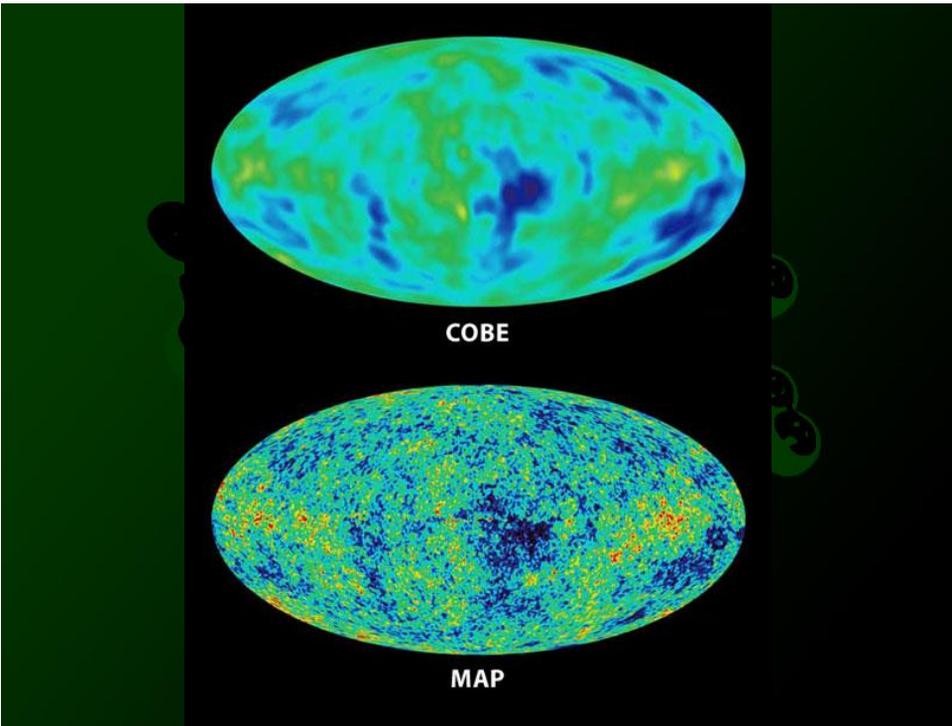
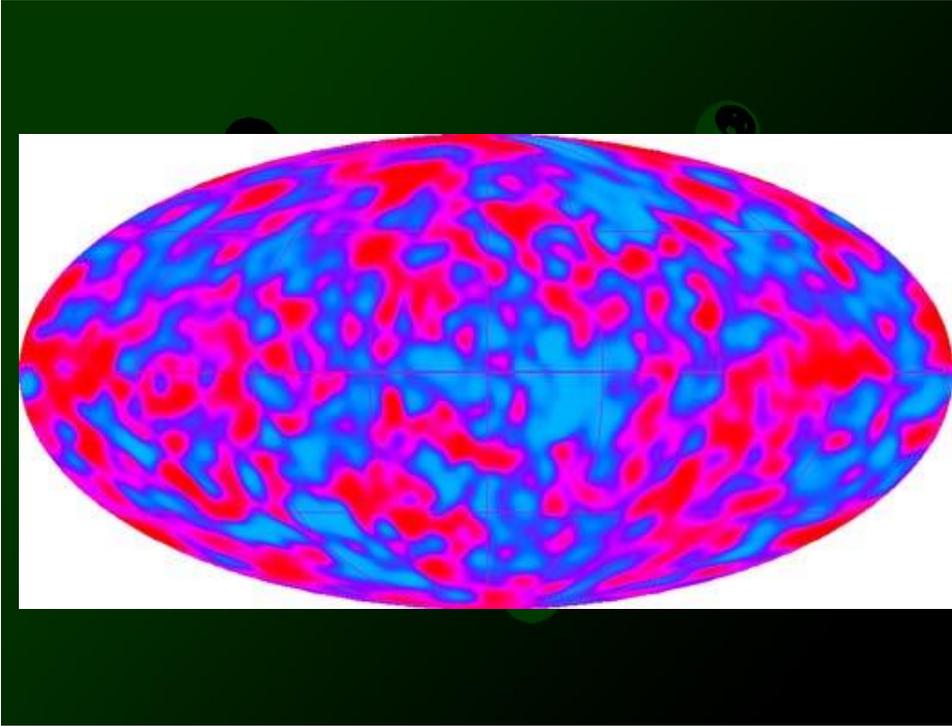
# Radiación de fondo

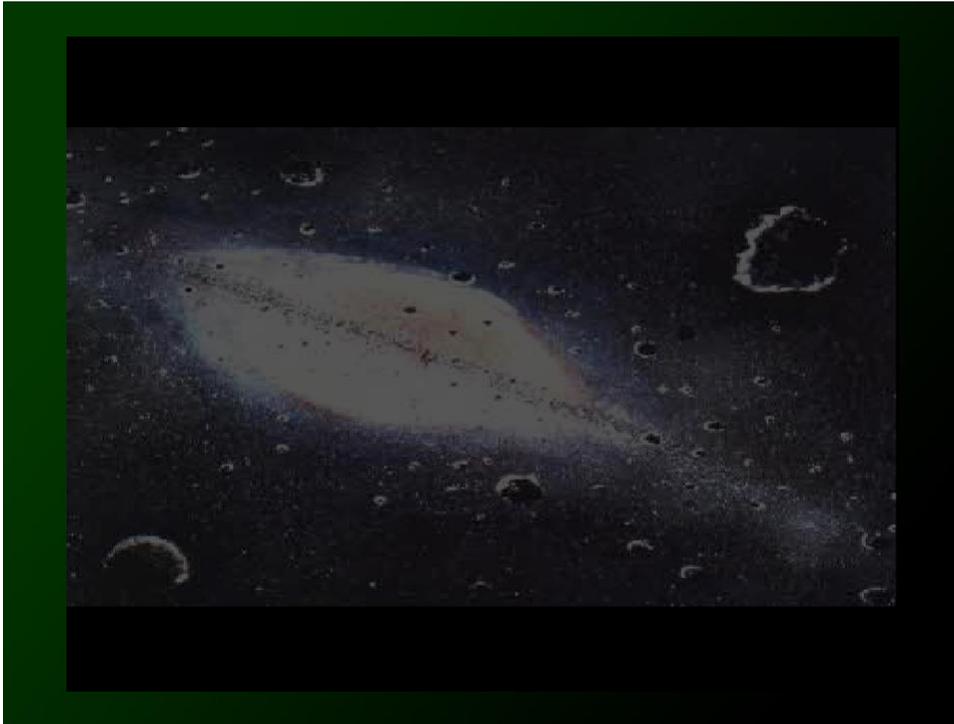
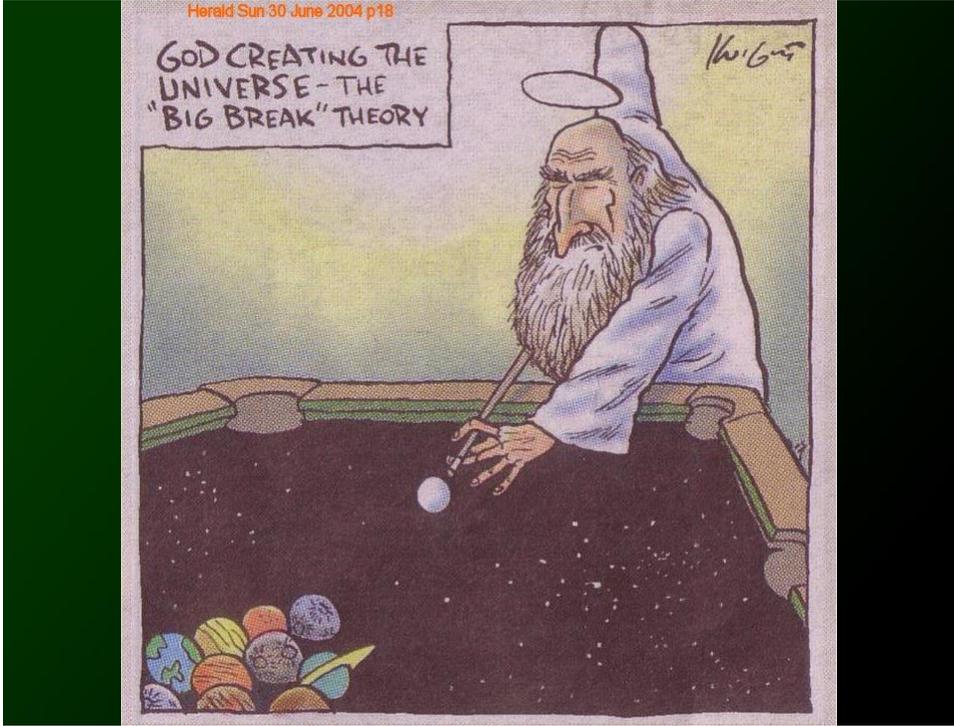
## SPECTRUM OF THE COSMIC MICROWAVE BACKGROUND

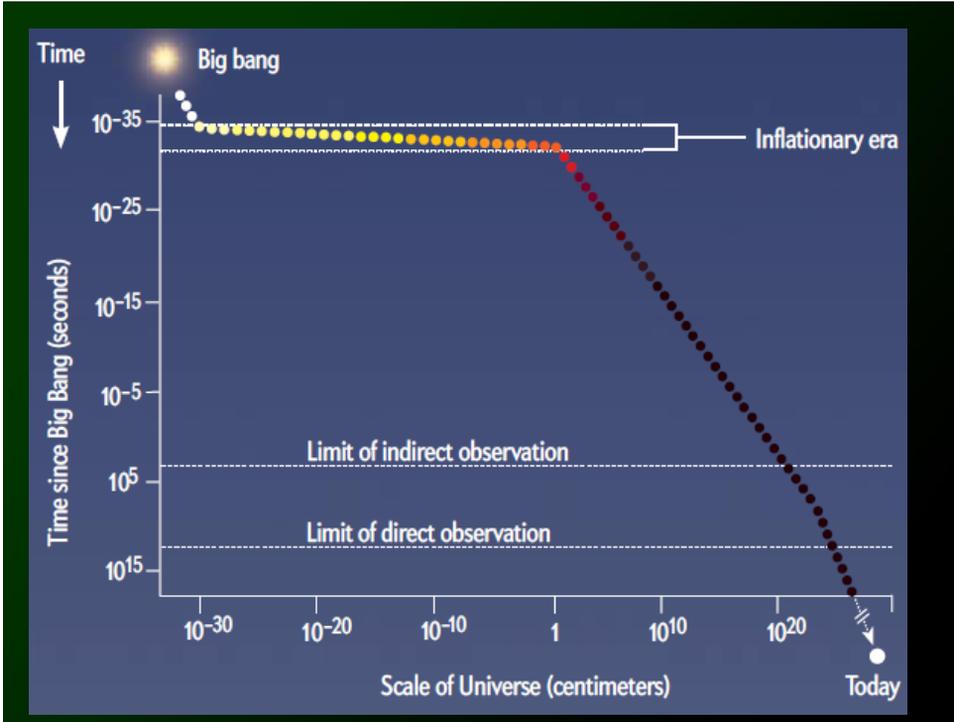
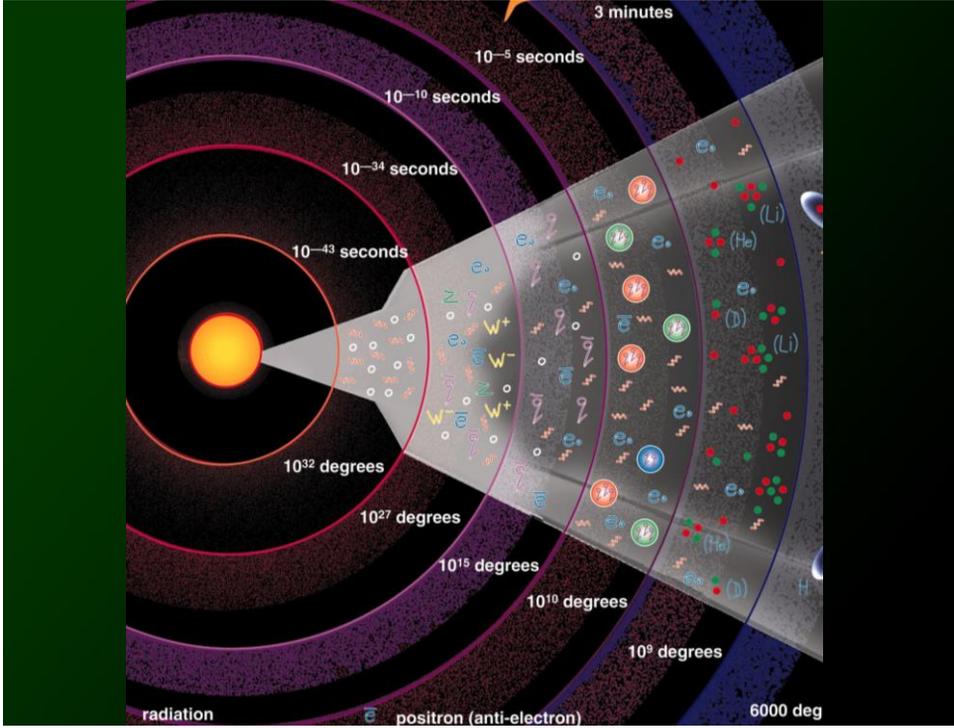


# Cobe









## En resumen las evidencias experimentales

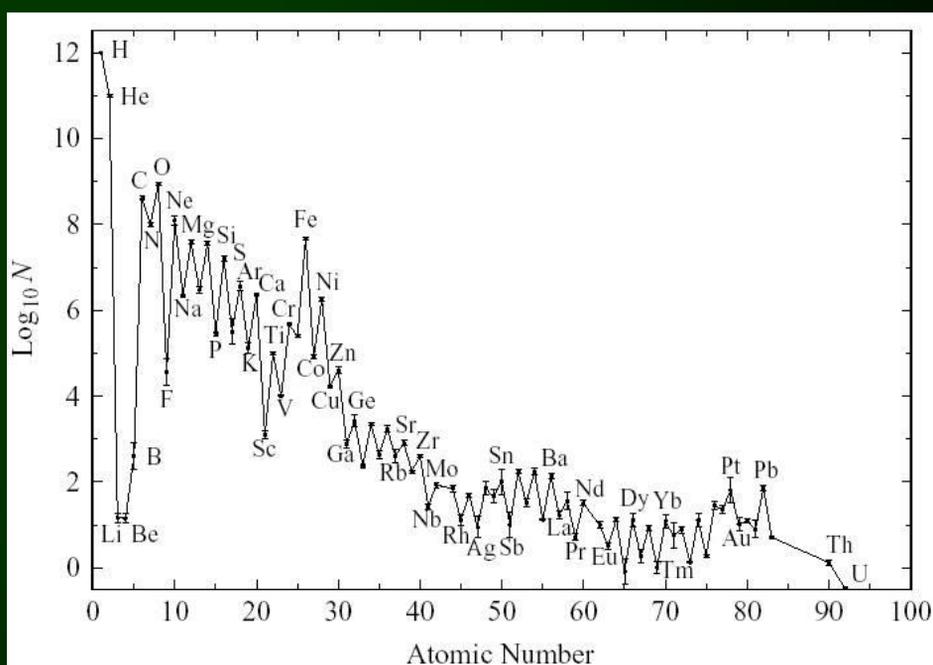
- Radiación de fondo
- Las galaxias, estrella y demás objetos se alejan radialmente con respecto a un punto.
- Abundancia de elementos

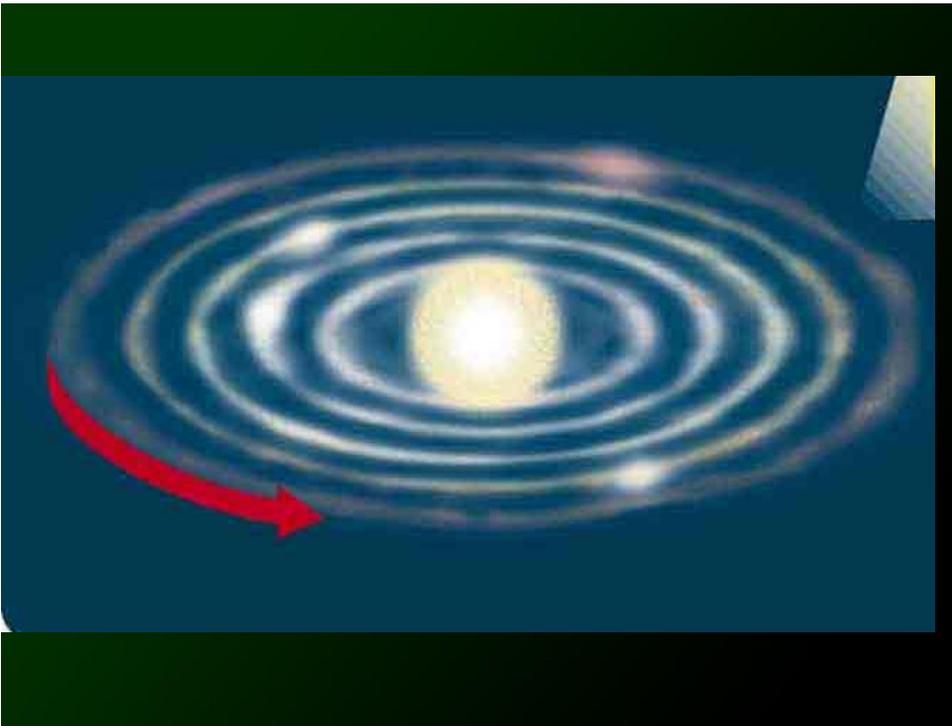
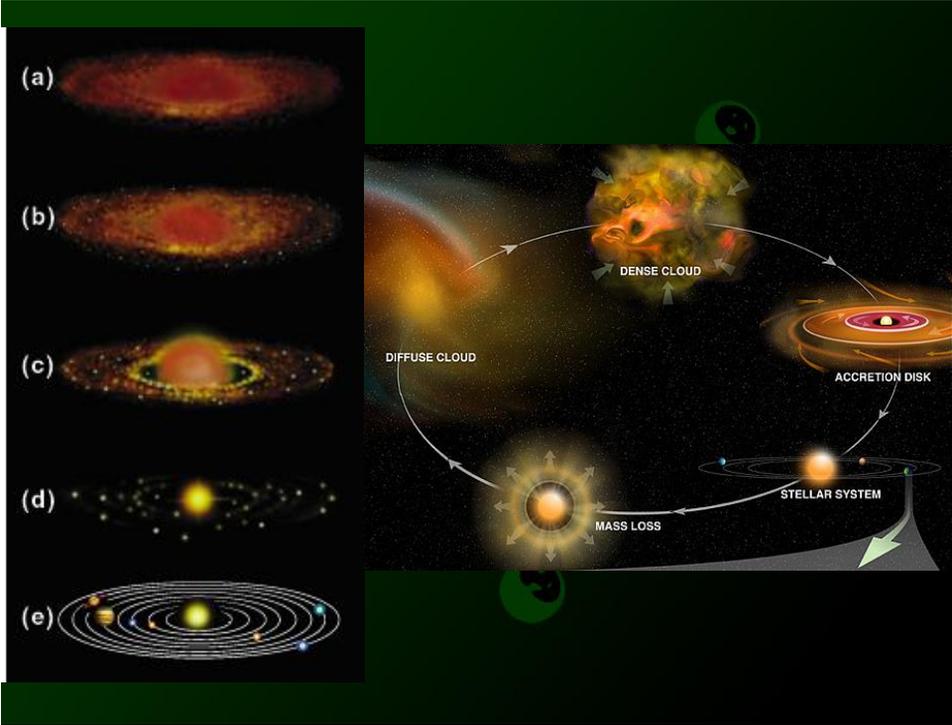
## Conclusión del Big-Bang

- La temperatura y presión bajaron rápidamente
- Solo se formó:
  - Hidrógeno
  - Helio
  - Un poco de litio

## ¿Solo tenemos 3 elementos en el Universo?

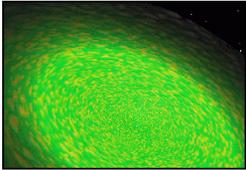
- En el Universo primitivo (aprox. 15 000 millones de años) SI
- ¿Y ahora?
- ¿De donde salieron los otros?



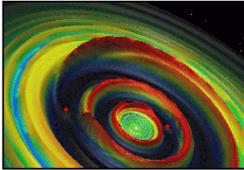


### Evolution of Two Neighboring Planets in a Protostellar Disk

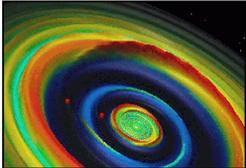
I. Initial Disk



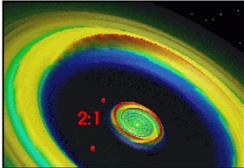
II. Gap Formation



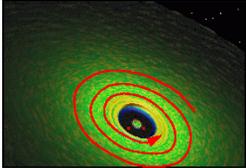
III. Gas Ring Dissipation



IV. Resonant Configuration

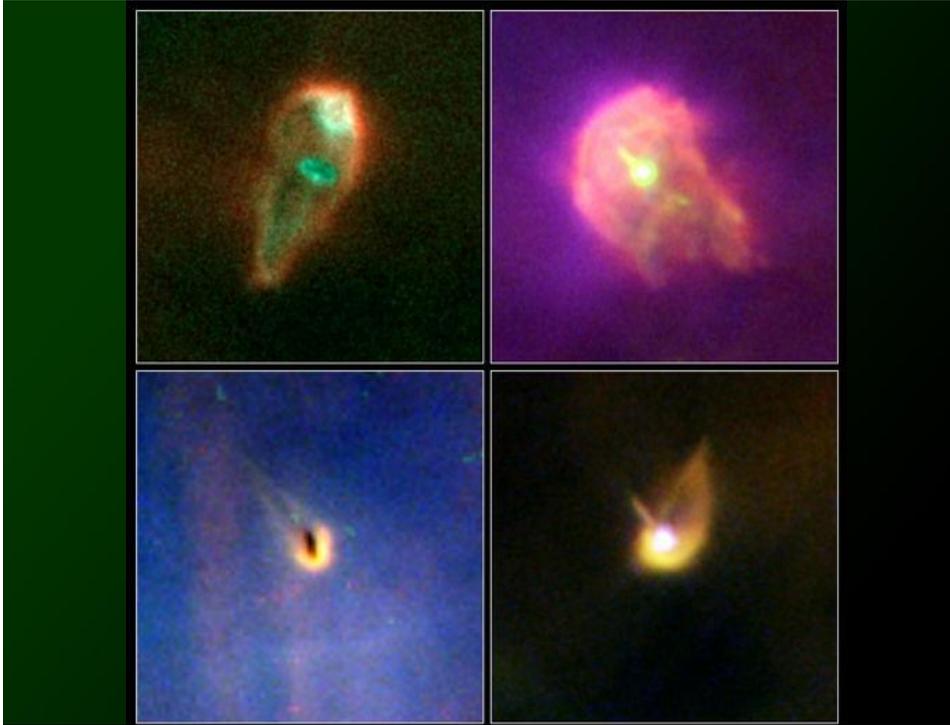


V. Inward Migration



VI. Disk Evaporation





Se formaron las estrellas

¿SON TODAS IGUALES?

• Las Grandes > 8 soles másicas

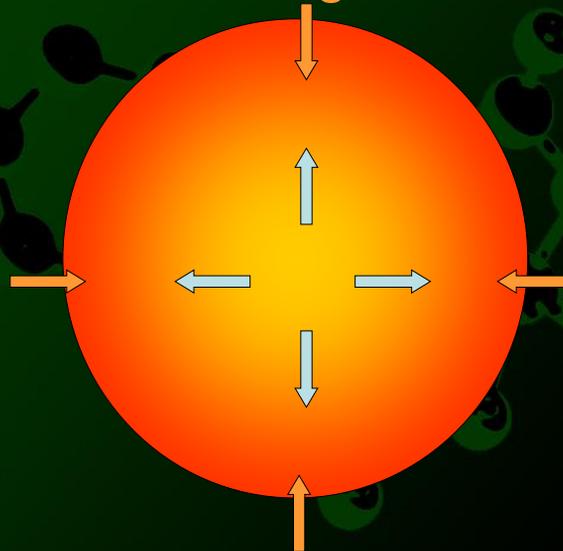
• y las chicas > 8 soles no másicas

## Principal reacción



Durante la mayor parte de la vida de una estrella se consume el deuterio y se forma Helio. En esta etapa la estrella está en un equilibrio entre la contracción gravitatoria y la expansión por temperatura

## Contracción gravitatoria



Expansión por efecto del aumento de la temperatura

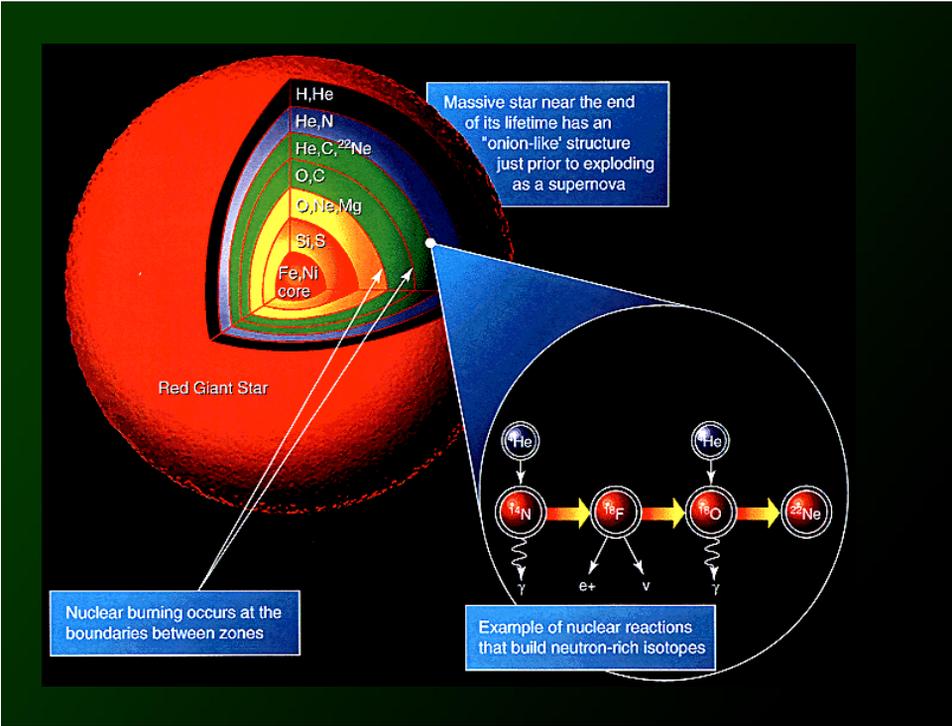
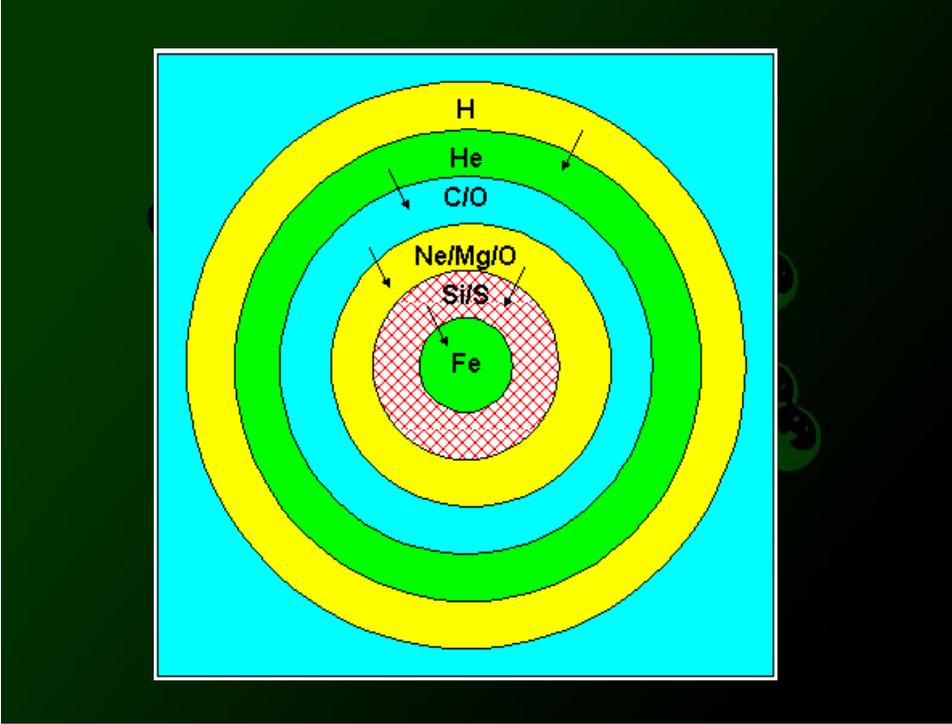
## Cuando se comienza a acabar el Hidrógeno....

- Otras reacciones comienzan a ser mas posibles, la principal es la captura de helio 4.
- $\text{He}^4 + \text{He}^4 \rightarrow \text{Be}^8 + \gamma$
- $\text{He}^4 + \text{Be}^8 \rightarrow \text{C}^{12} + \gamma$
- Hasta.....

**Reacciones exotérmicas**



**Reacción endotérmica**



La estrella se enfriará poco a poco  
y morirá de diferente forma  
dependiendo su masa

Másicas



Supernovas

No  
Másicas



Se apagarán

Másicas



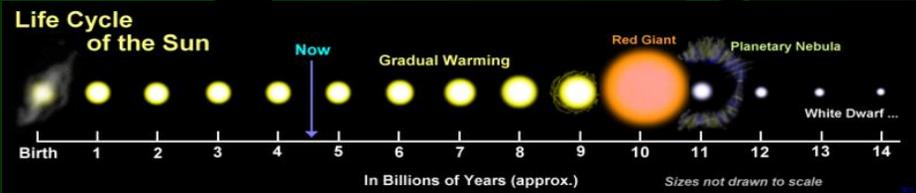
??????

No  
Másicas



Del Helio al  
 $Fe^{56}$

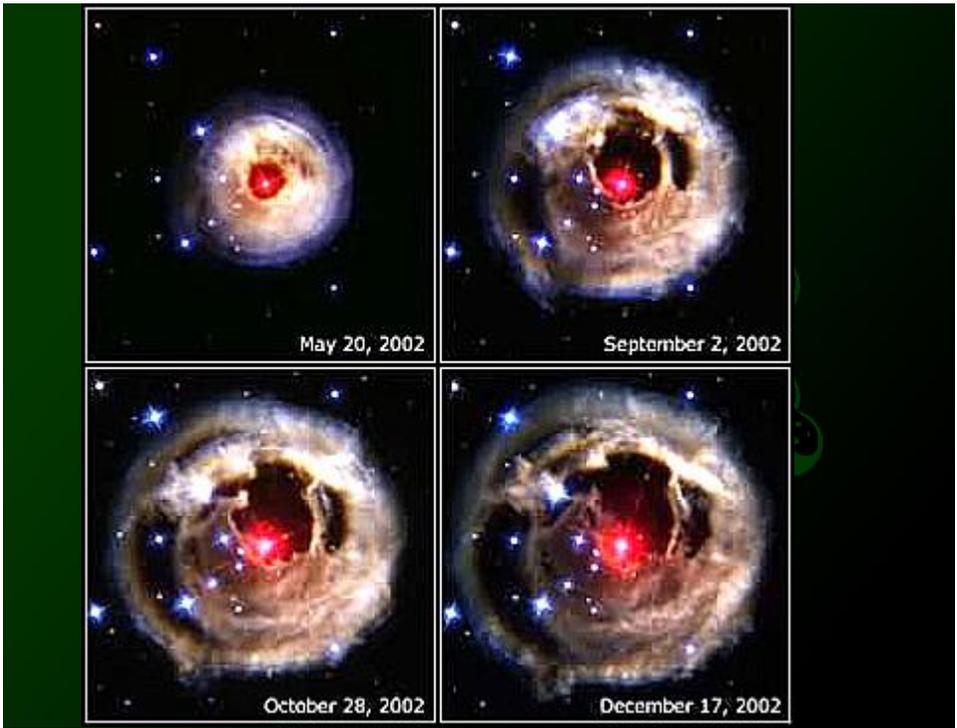
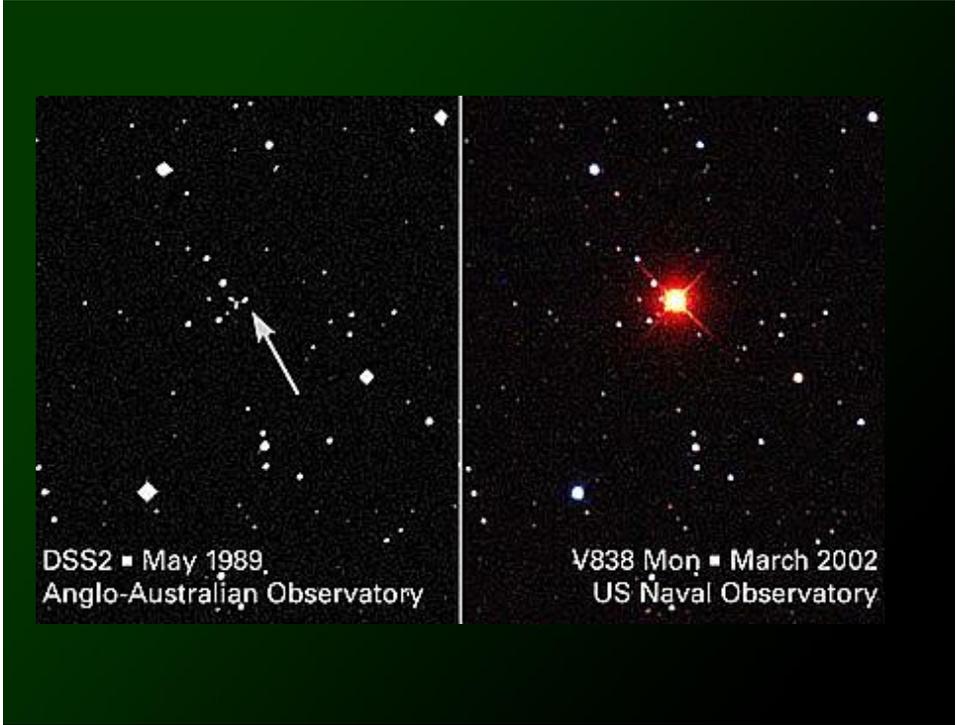
# No másicas (como nuestro sol)

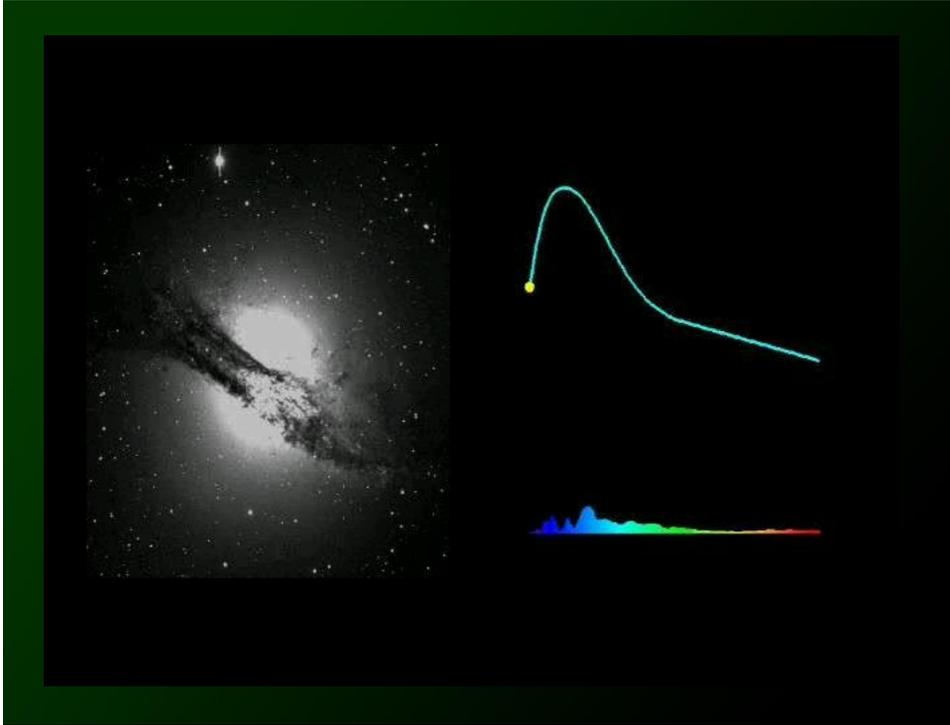


De Hidrógeno a Helio

De Litio a <sup>56</sup>Fe





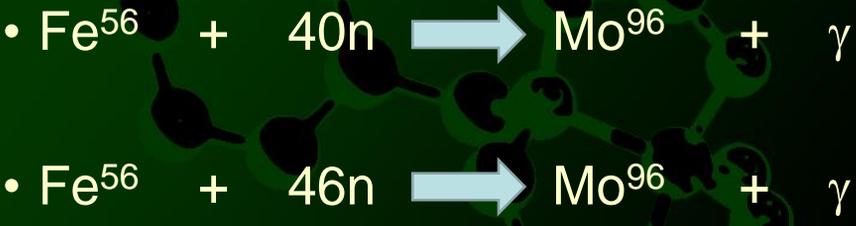


## Que hizo cobe

- Espectro de rayos gama

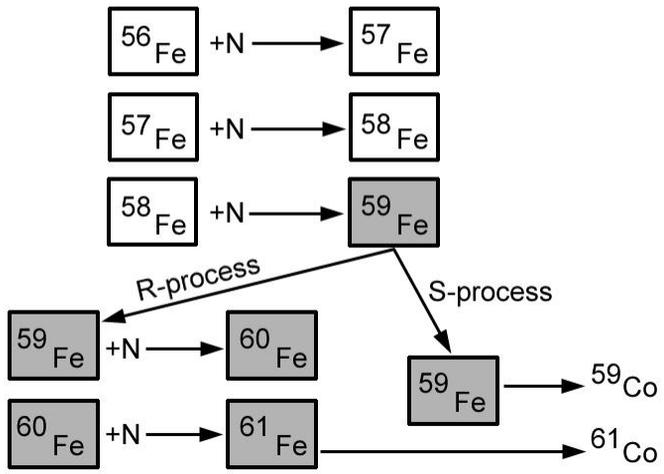


# Captura rápida de neutrones



## Formation of Cobalt from Neutron Capture

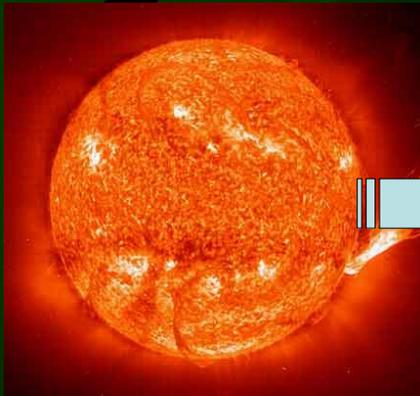
= stable isotope     = unstable isotope

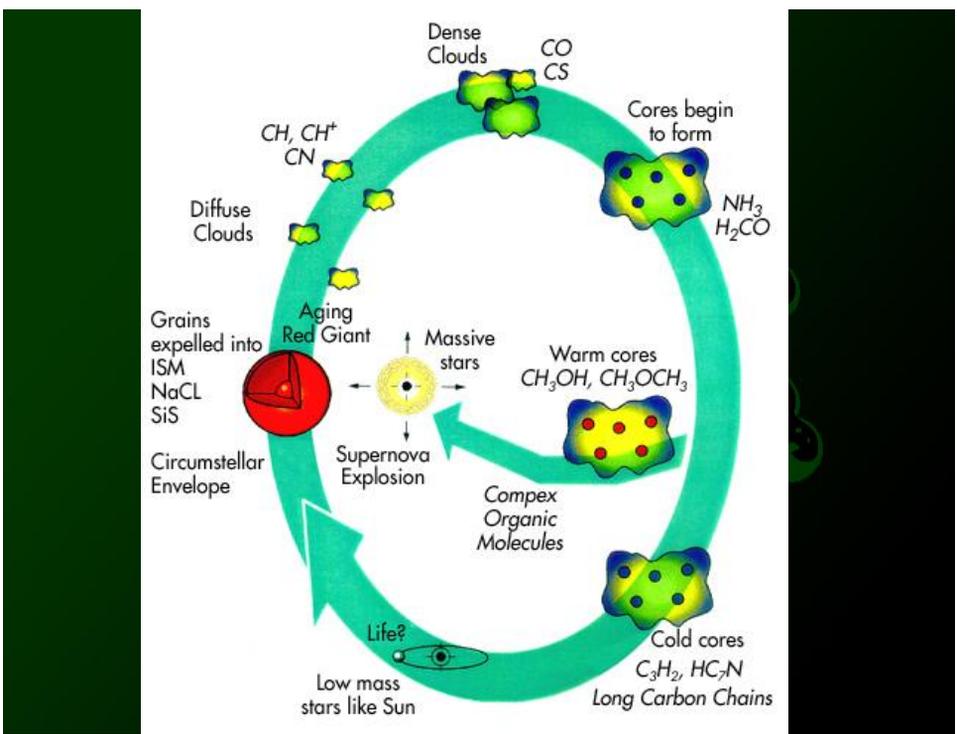
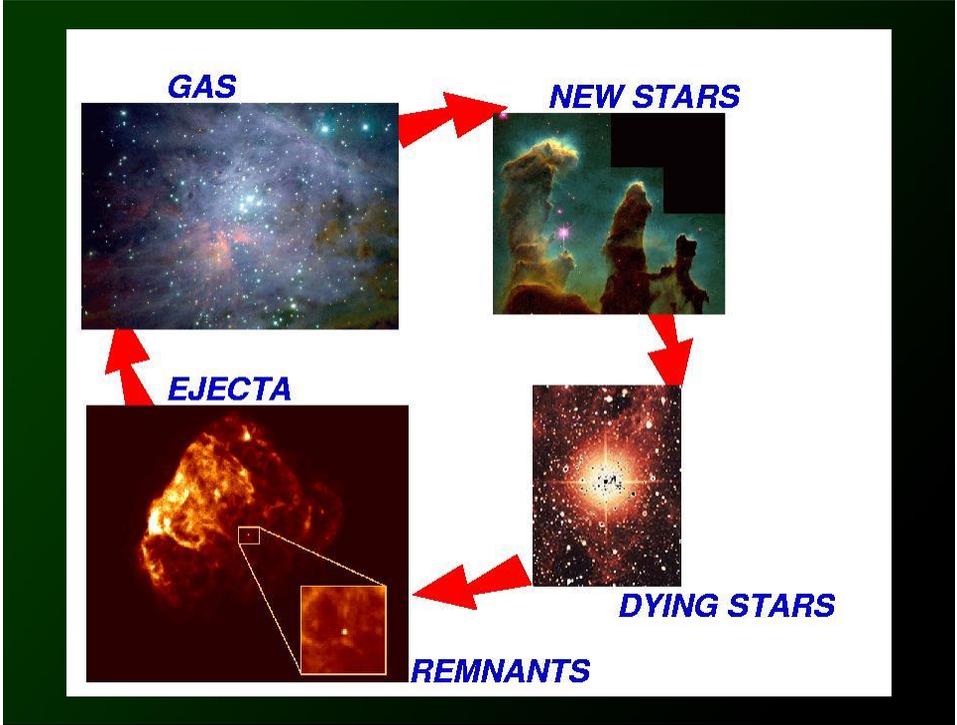


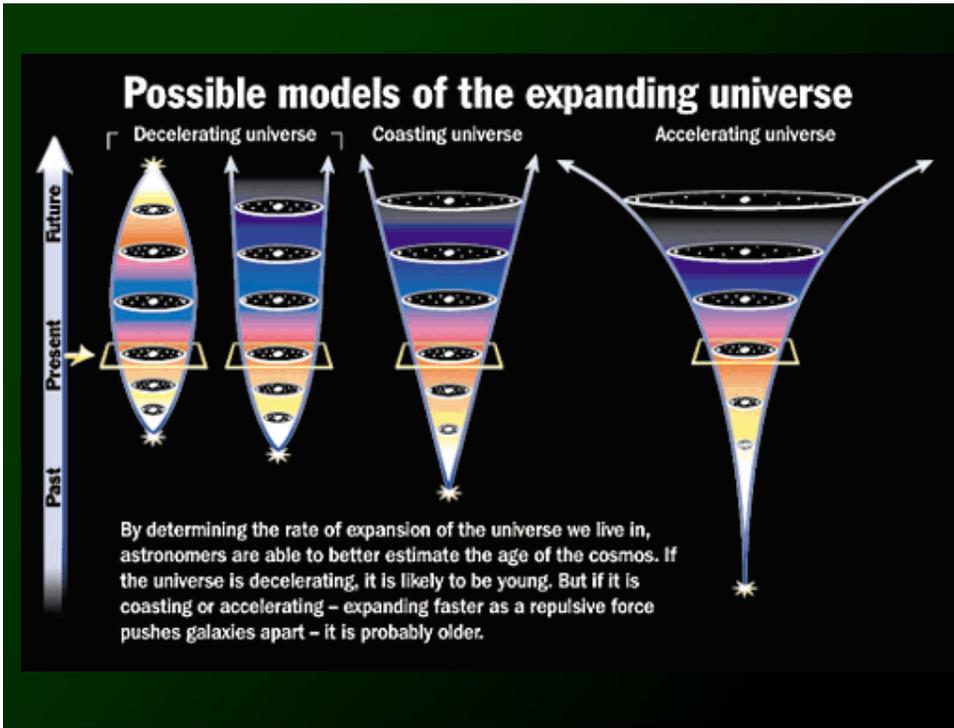
## No másica

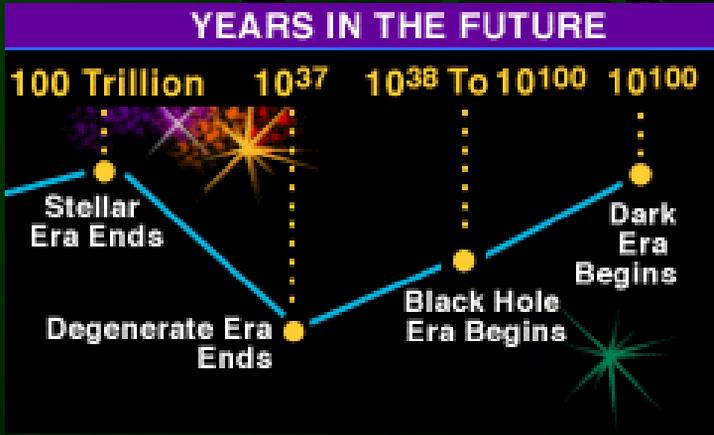
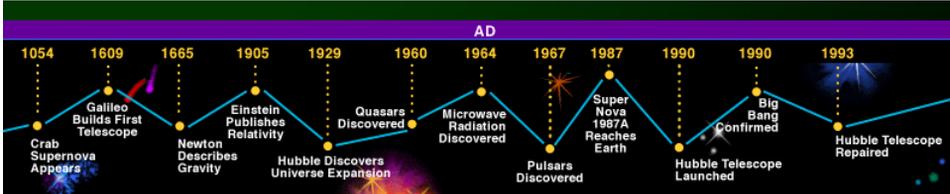
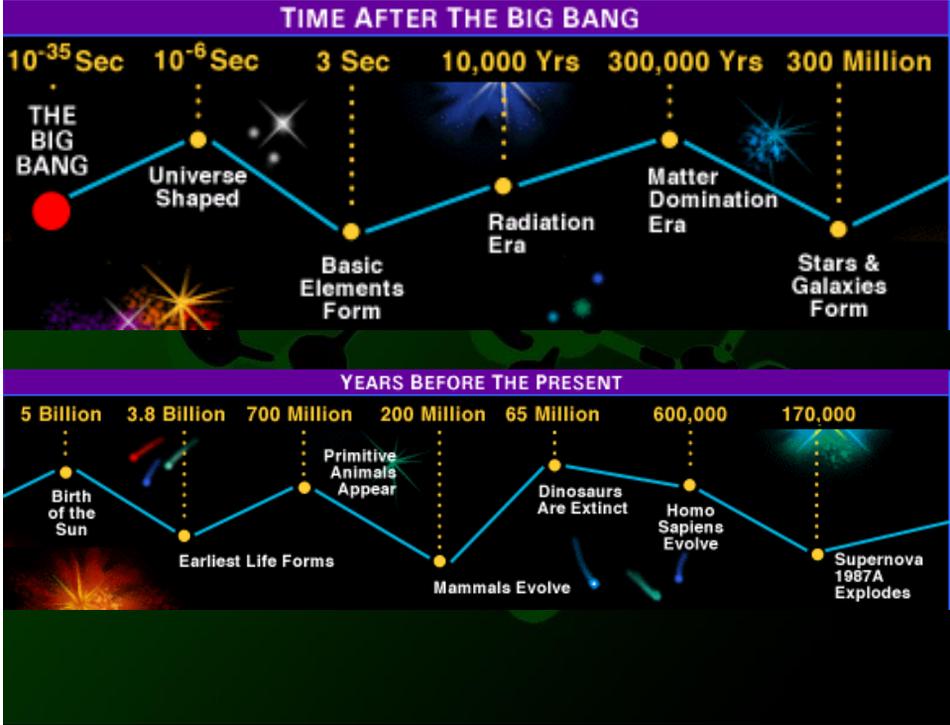
- Cuando esta cerca de morir produce elementos mas pesados que el helio su temperatura aumenta y la estrella se expande

## Gigante roja



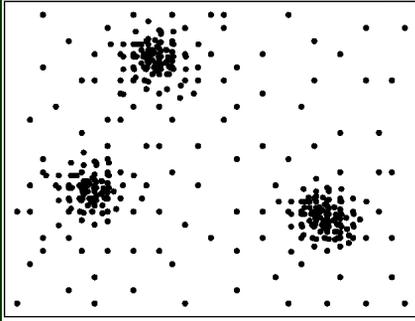




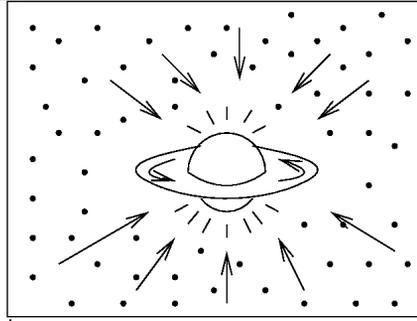


# ¿Como acabará el Universo?

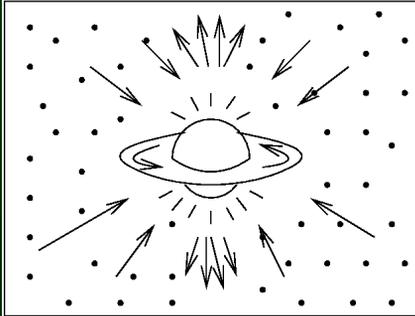




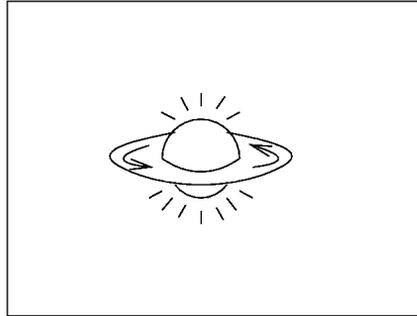
a.



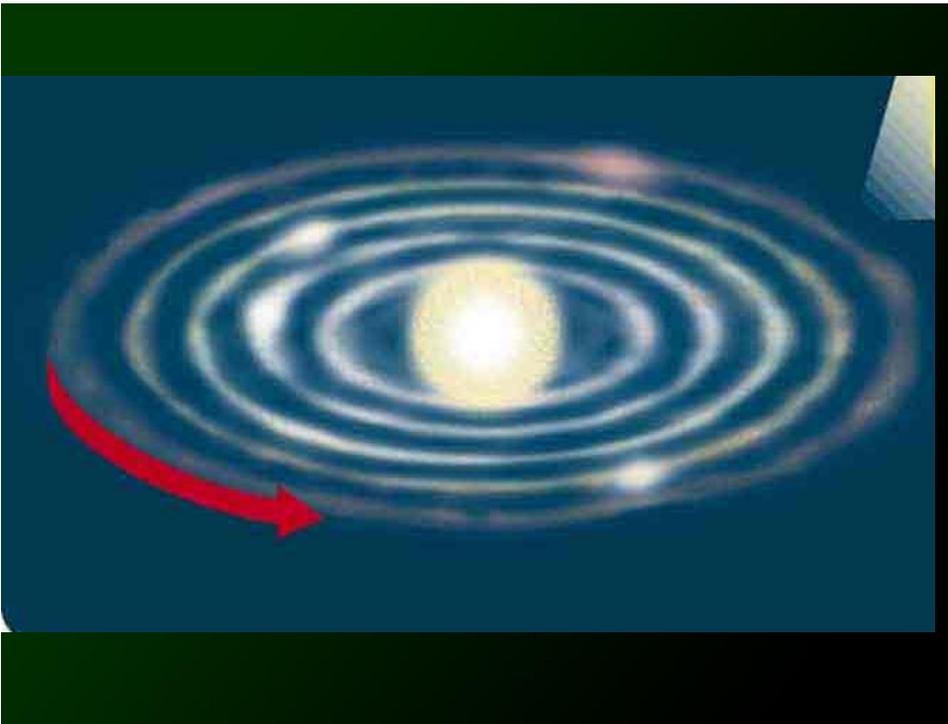
b.



c.

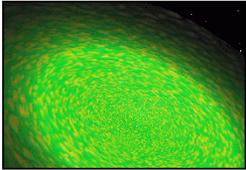


d.

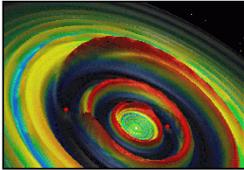


### Evolution of Two Neighboring Planets in a Protostellar Disk

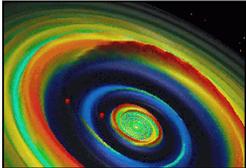
I. Initial Disk



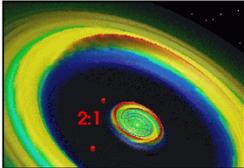
II. Gap Formation



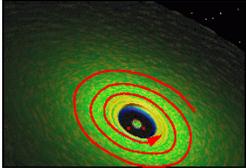
III. Gas Ring Dissipation



IV. Resonant Configuration

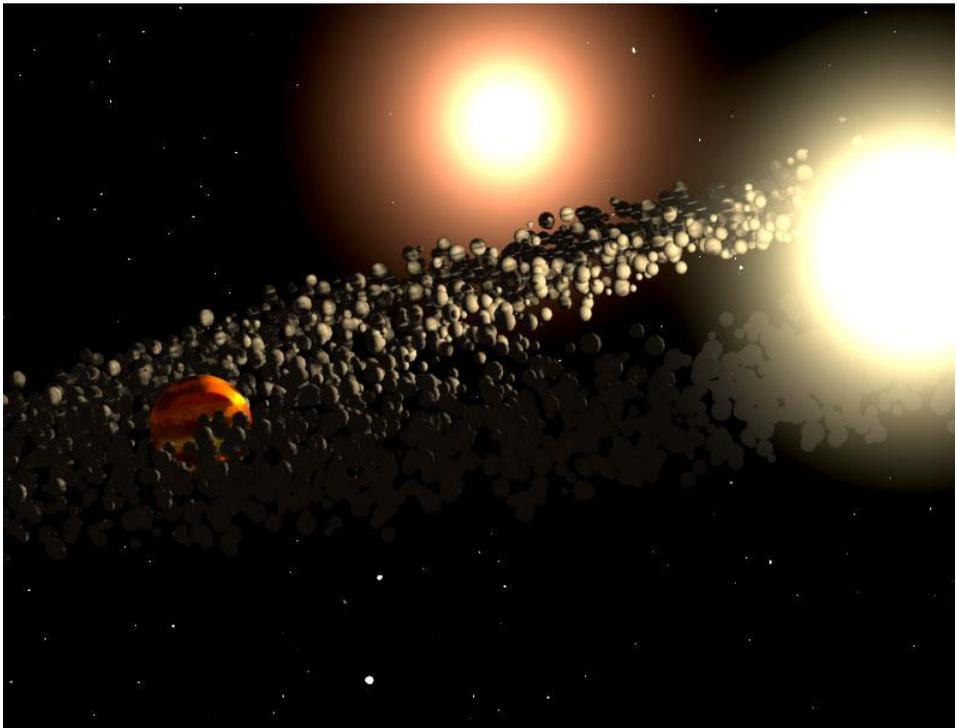
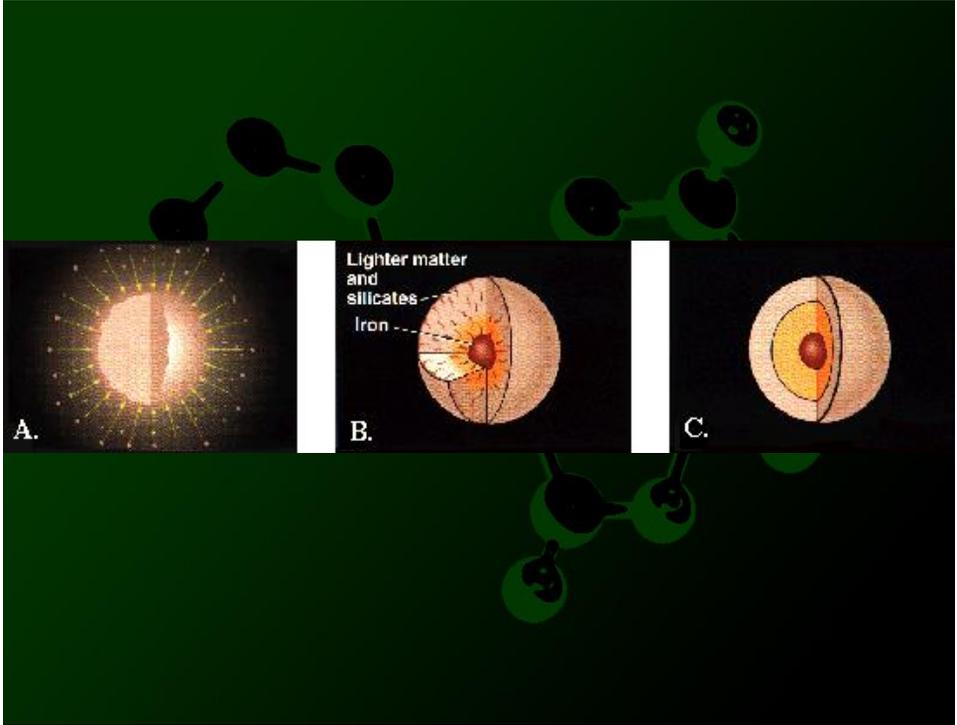


V. Inward Migration

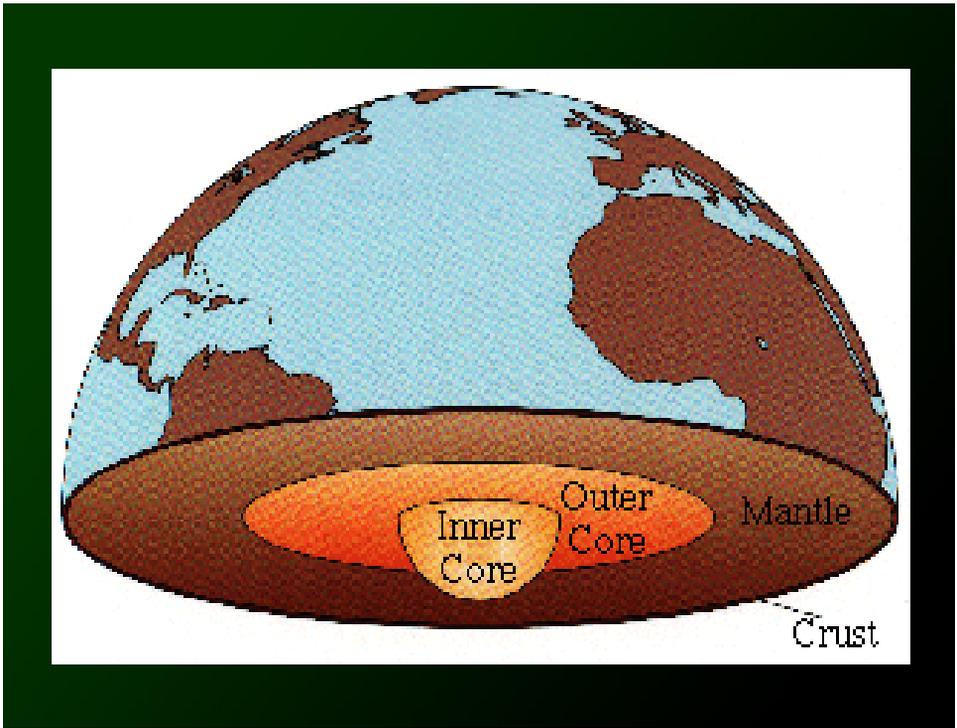
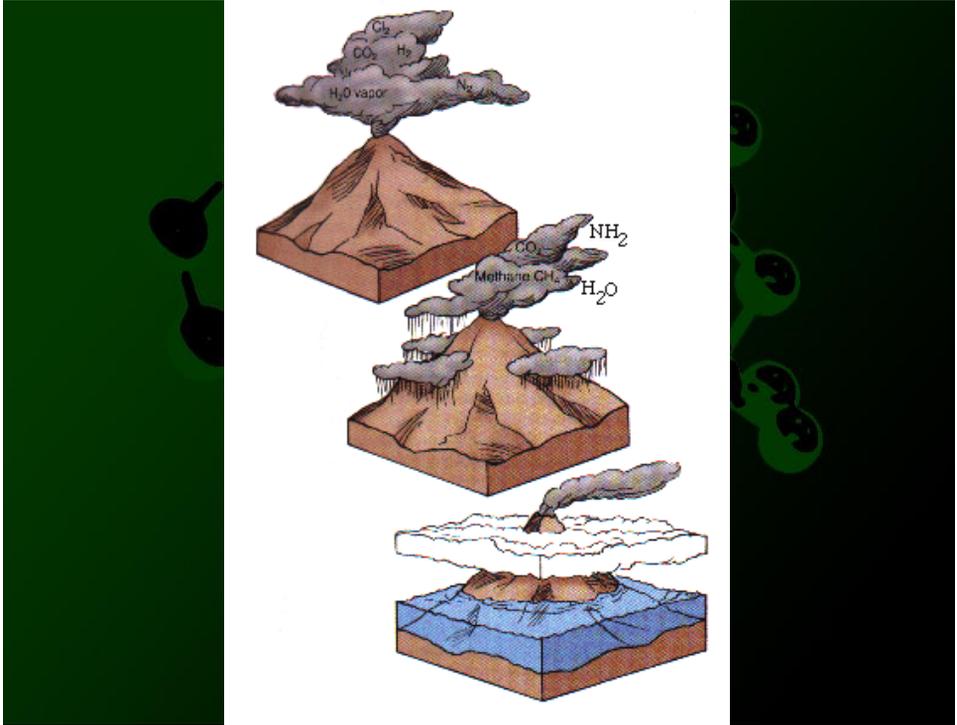


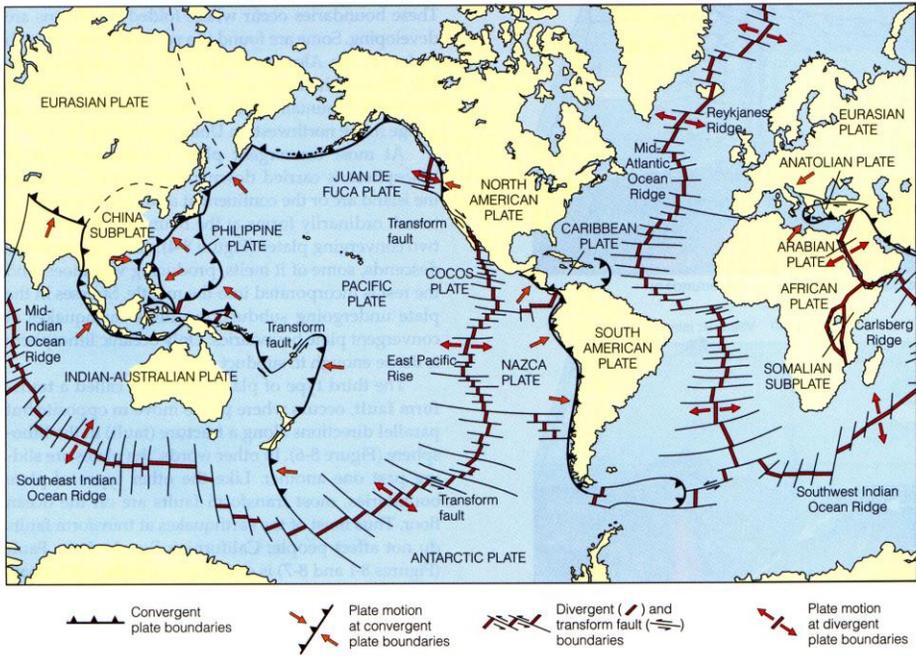
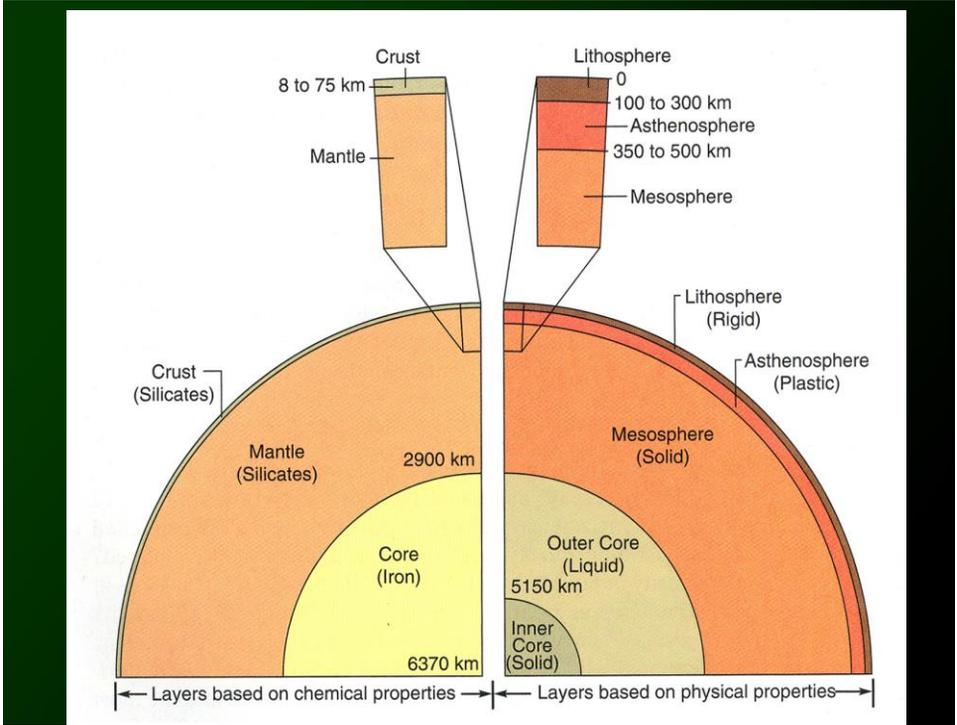
VI. Disk Evaporation

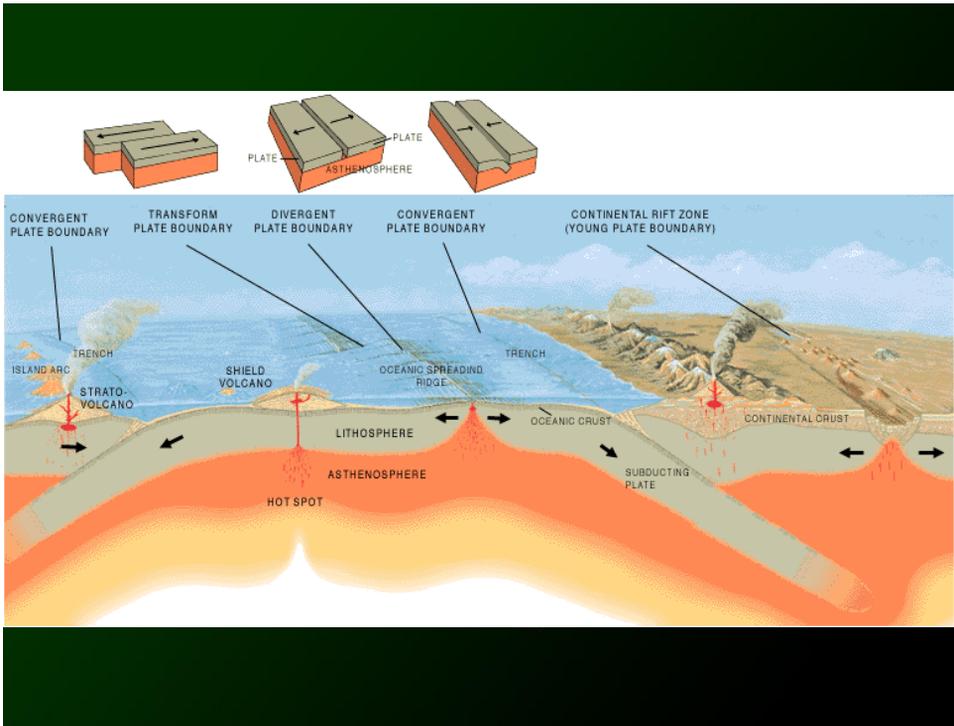
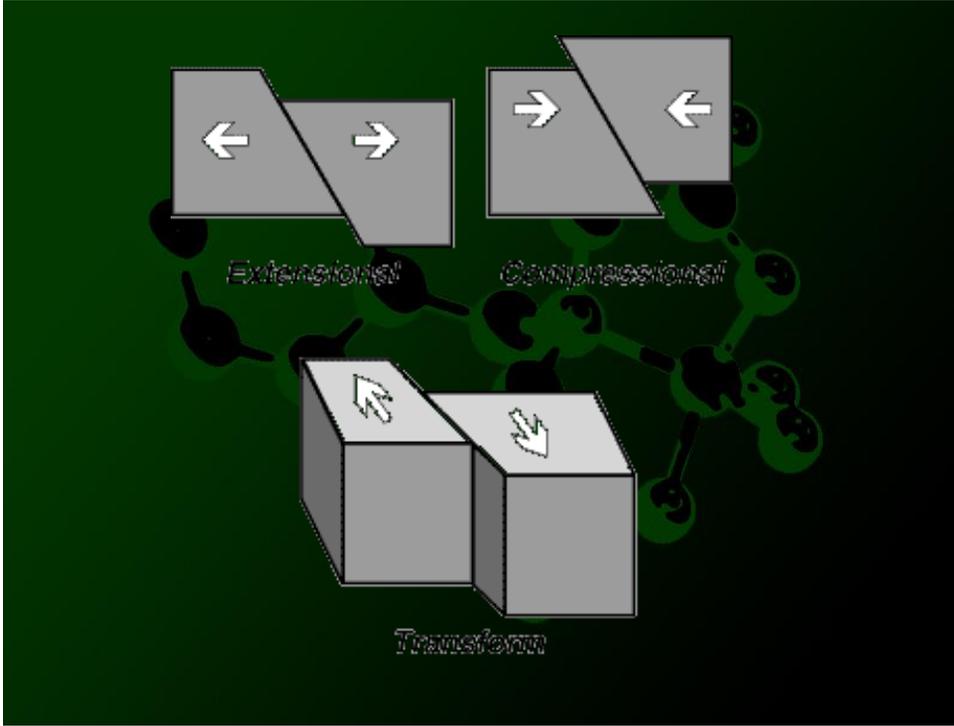


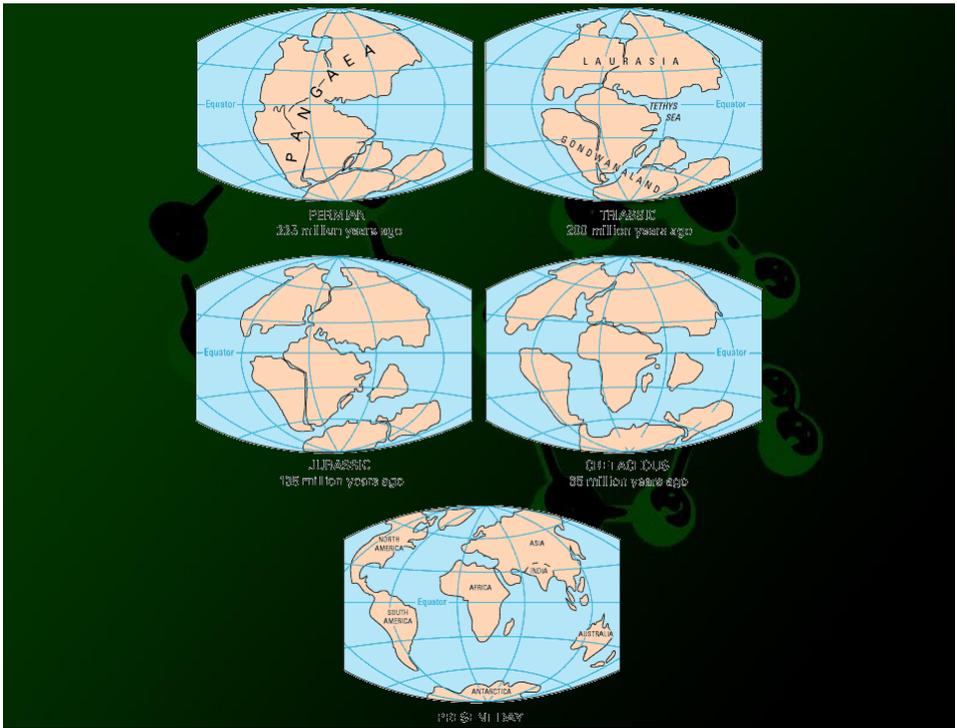
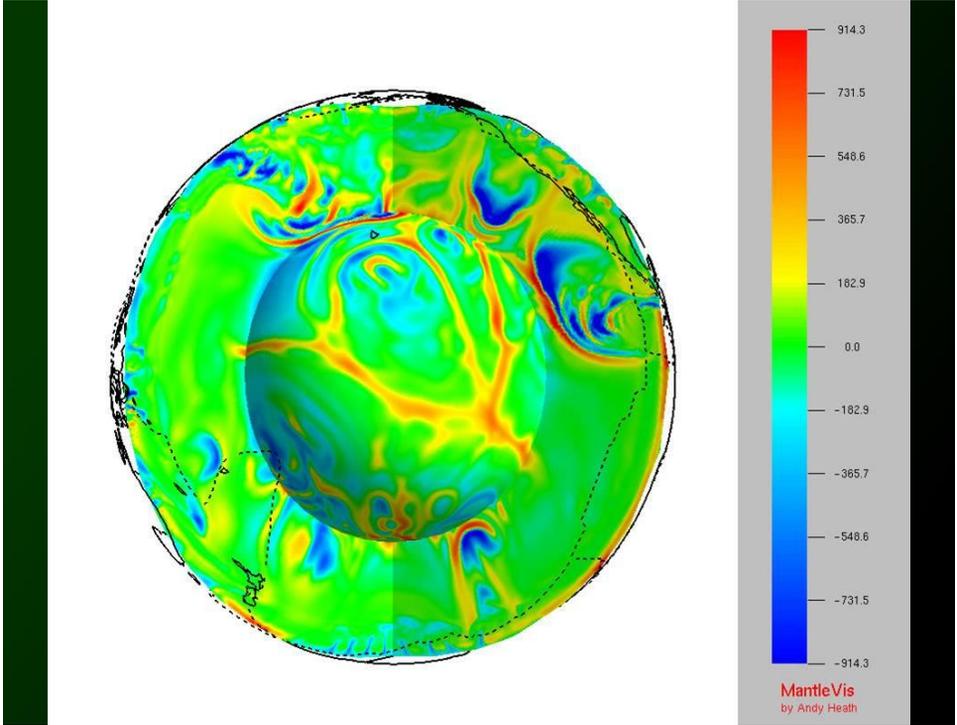


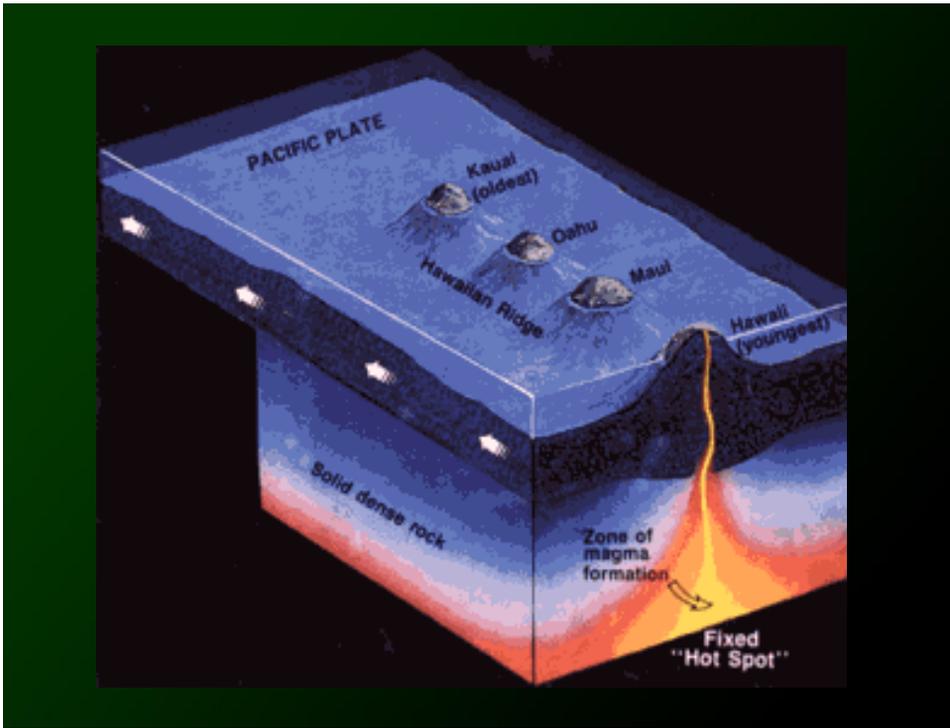
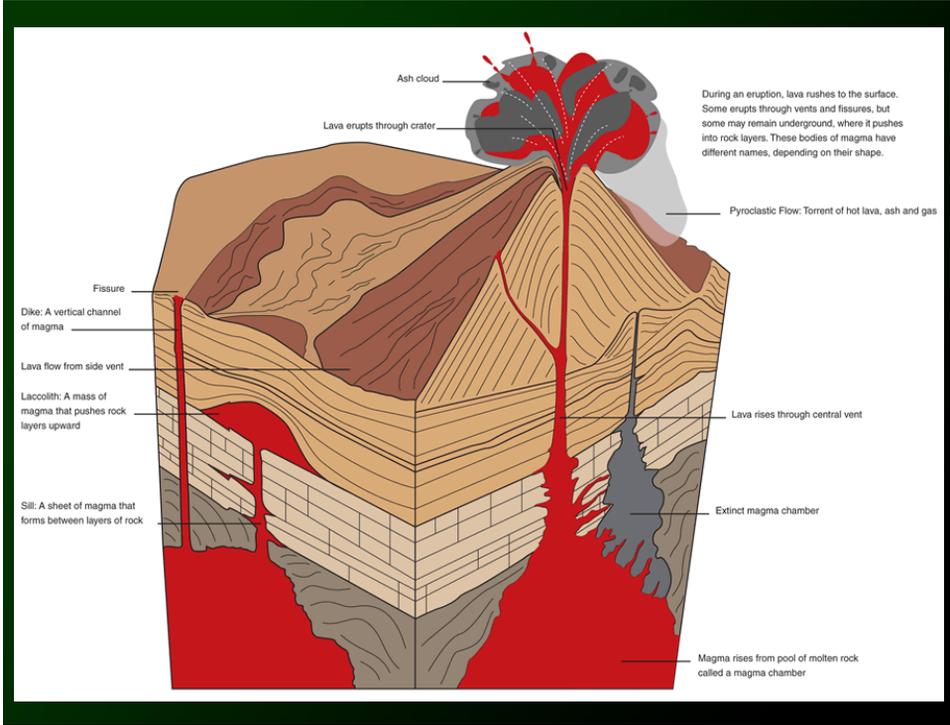


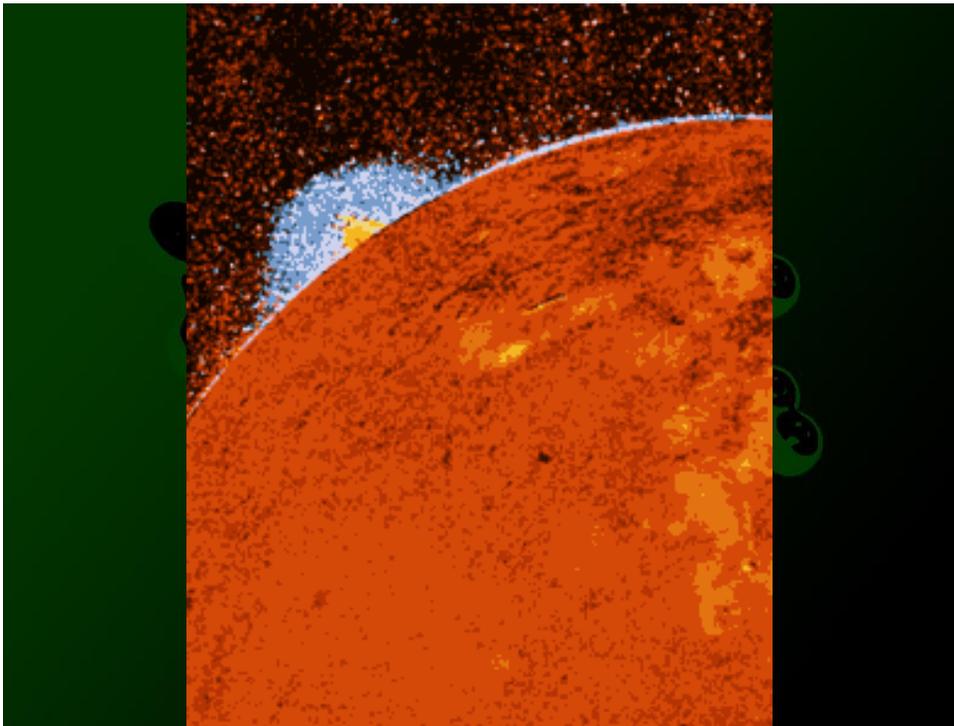






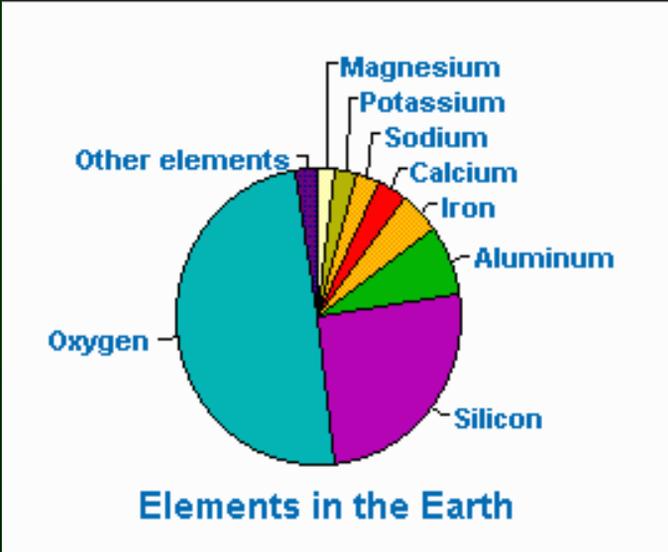
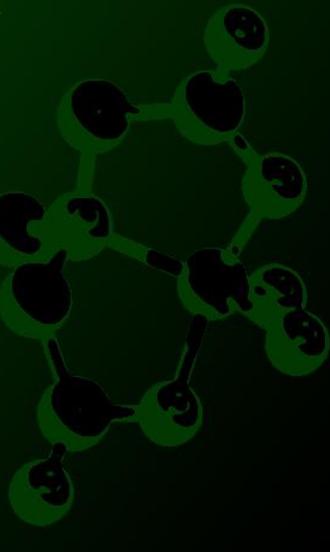




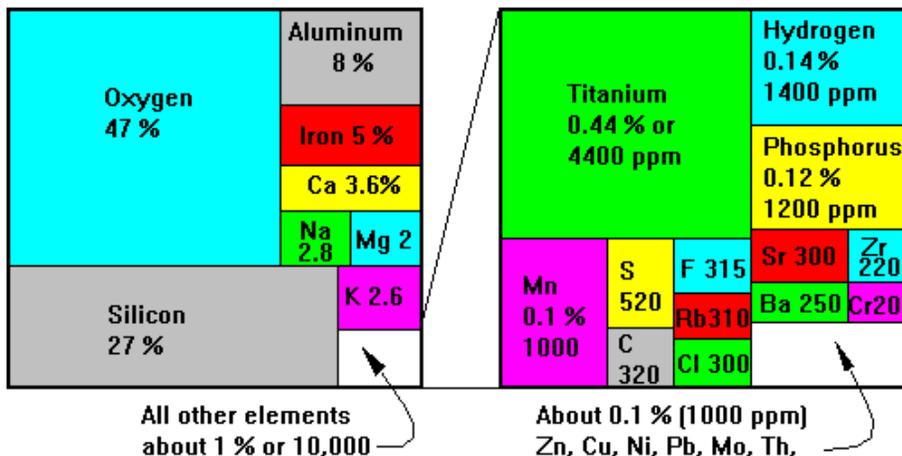


# Abundancia en corteza

Element	Approximate % by weight
Oxygen	46.6
Silicon	27.7
Aluminum	8.1
Iron	5.0
Calcium	3.6
Sodium	2.8
Potassium	2.6
Magnesium	2.1
All others	1.5

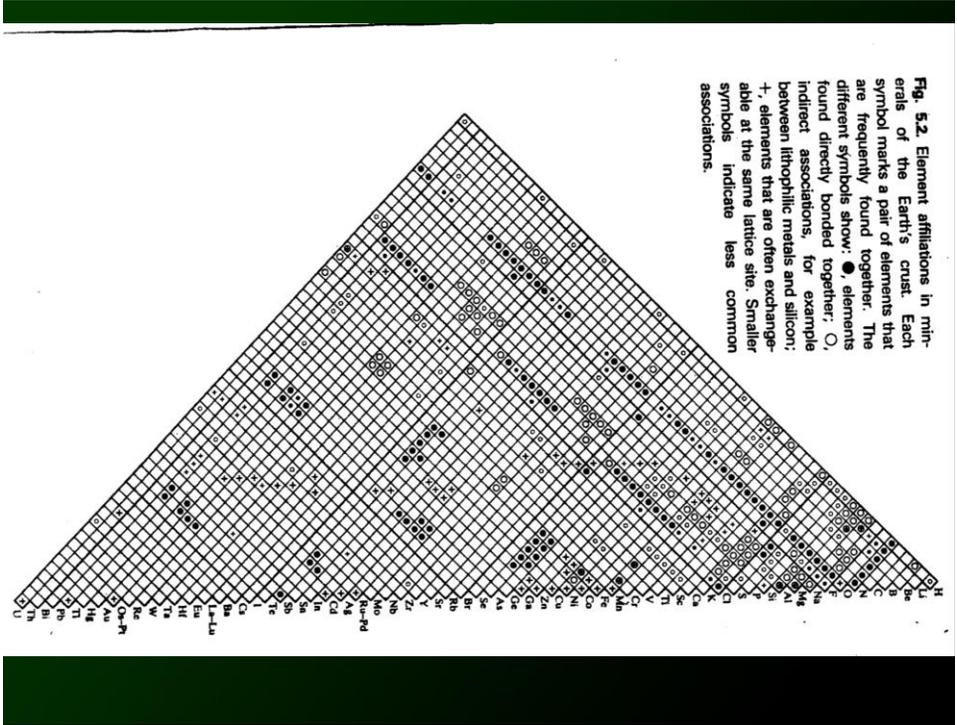


**Chemistry of Continental Crust by Weight**



**Estimated Abundance of Elements (in relative atomic %)**

Earth		Earth's crust		Earth's Atmosphere	
Oxygen	50	Oxygen	47	Nitrogen	78
Iron	17	Silicon	28	Oxygen	21
Silicon	14	Aluminium	8.1	Argon	0.93
Magnesium	14	Iron	5.0	Carbon	0.03
Sulphur	1.6	Calcium	3.6	Neon	0.0018
Nickel	1.1	Sodium	2.8	Helium	0.00052
Aluminium	1.1	Potassium	2.6		
Universe		Sun		Humans	
Hydrogen	92.47	Hydrogen	90.99	Hydrogen	61
Helium	7.40	Helium	8.87	Oxygen	26
Oxygen	0.06	Oxygen	0.078	Carbon	10.5
Carbon	0.03	Carbon	0.033	Nitrogen	2.4
Nitrogen	0.01	Neon	0.011	Calcium	0.23
Neon	0.01	Nitrogen	0.010	Phosphorus	0.13
Others	0.01	Magnesium	0.004	Sulphur	0.13



# Clasificación

- Ígneas, metamórficas y sedimentarias
- Siderófilos, calcófilos, atmófilos, litófilos.

ÍNDICE FÍSICO DE LA PRODUCCIÓN MINERA POR RAMA DE ACTIVIDAD ECONÓMICA Base 1993=100.				
Rama	1995	1996	1997 (1)	
Extracción y beneficio de carbón y granito	114,1	128,7	125,1	
Extracción de petróleo crudo y gas natural	98,8	107,9	112,1	
Extracción y beneficio de mineral de hierro	102,6	112,6	111,3	
Extracción y beneficio de minerales metálicos no ferrosos	114,8	117,9	122,5	

PRODUCCIÓN MINERO-METALÚRGICA En toneladas.					
Mineral	1993	1994	1995	1996	1997 (1)
Metales no ferrosos (2)					
Plomo	179.675	163.381	179.741	167.115	121.248
Cobre	301.097	302.697	339.347	327.976	223.774
Zinc	334.232	357.143	354.673	348.329	246.889
Antimonio	1.494	1.757	1.783	984	683
Arsénico	4.447	4.439	3.620	2.943	2.039
Bismuto	911	1.048	994	1.071	1.268
Estaño	1	3	1	2	1
Cadmio	1.436	1.852	1.756	1.814	1.221
Tungsteno	0	0	286	189	124
Molibdeno	2.577	2.614	3.881	4.202	3.239

Minerales no metálicos (3)					
Azufre (4)	906.000	877.000	882.414	921.349	608.312
Grafito	40.000	30.000	34.388	40.412	32.726
Barita	123.000	86.000	248.369	470.028	165.372
Dolomita	460.000	601.000	931.770	929.933	617.981
Fluorita	282.000	323.000	522.657	523.970	313.033
Sílice (5)	1.310.000	1.360.000	1.292.265	1.424.824	1.040.405
Yeso	2.837.000	3.428.000	3.447.840	3.758.923	2.848.155
Fosforita	228.000	537.000	622.359	682.079	478.254
Wallastonita	1.010	284	0	2.524	1.838
Celestita	69.754	111.485	138.340	141.140	86.670
Feldespató	122.752	134.440	121.780	139.970	102.593
Caolín	12.356	8.927	6.824	14.215	6.536

VOLUMEN DE PRODUCCIÓN DE METALES PRECIOSOS En kilogramos.		
Año	Oro (1)	Plata (2)
1993	11.413	2.366.390
1994	14.432	2.325.423
1995	20.902	2.315.552
1996	24.083	2.536.465
1997 (2)	17.146	1.735.487

(1)  
Contenido  
metálico.  
(2) Enero-  
agosto.  
Fuente:  
INEGI y  
Dirección  
General de  
Minas.

PRODUCCIÓN DE OTROS MINERALES METÁLICOS					
En toneladas.					
Mineral	1993	1994	1995	1996	1997 (1)
Zinc (2)	334.232	357.143	354.673	348.329	246.889
Cobre (2)	301.097	302.697	339.347	327.976	223.774
Plomo (2)	179.675	163.681	179.741	167.115	121.248
Azufre (3)	906.000	877.000	882.414	921.349	608.312
Fluorita (4)	282.000	323.000	522.657	523.970	313.033

(1) Enero-agosto.  
(2) Contenido metálico.  
(3) Volumen del mineral. Incluye la extracción minera y el obtenido en la refinación del petróleo crudo.  
(4) Volumen del mineral.  
Fuente: Dirección General de Minas.

PRODUCCIÓN DE OTROS MINERALES						
En miles de toneladas.						
País	1970	1980	1990	1993	1994	1995
Carbón (1)	2.959,2	7.010,0	9.966,8	10.215,4	11.432,2	11.800,3
Cobre	61,0	175,4	291,3	301,0	305,5	319,0
Zinc (2)	266,4	238,1	306,7	359,7	362,8	395,9