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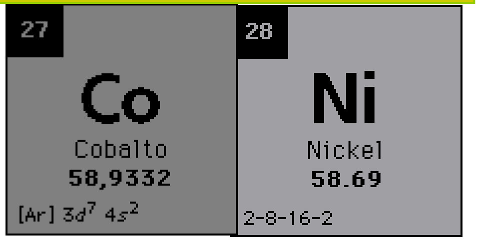
Resultados

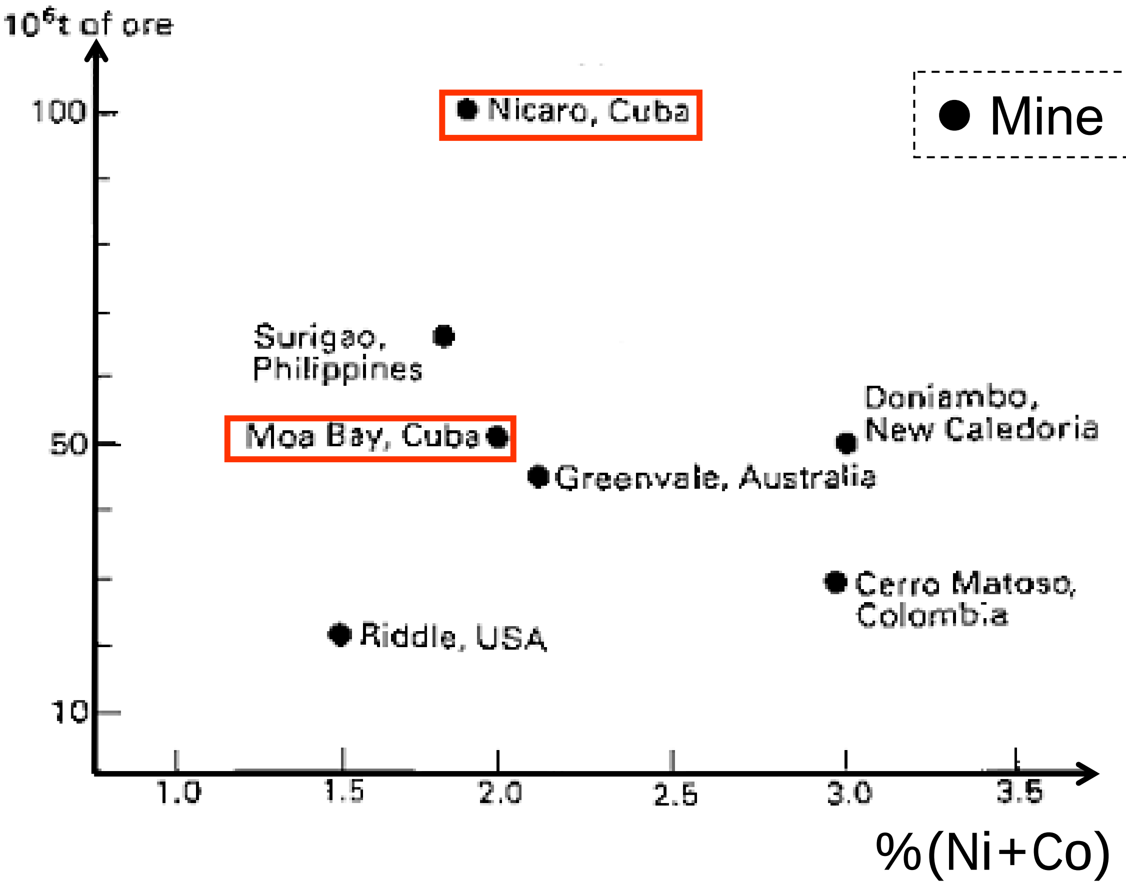
- ✓ Producción de antisueros contra tres especies de *Acidithiobacillus*.

Objetivo: Detectar microorganismos en procesos de biooxidación de azufre y de minerales refractario y en procesos de biolixiviación de minerales sulfurados, utilizando cultivos puros y mixtos. En el marco de la colaboración del proyecto SECYT-CITMA.

BIOLIXIVIACIÓN DEUN RESIDUAL DE LA INDUSTRIA NIQUELIFERA .

Cuba serpentine deposits: richest deposits of nickel and cobalt in the world



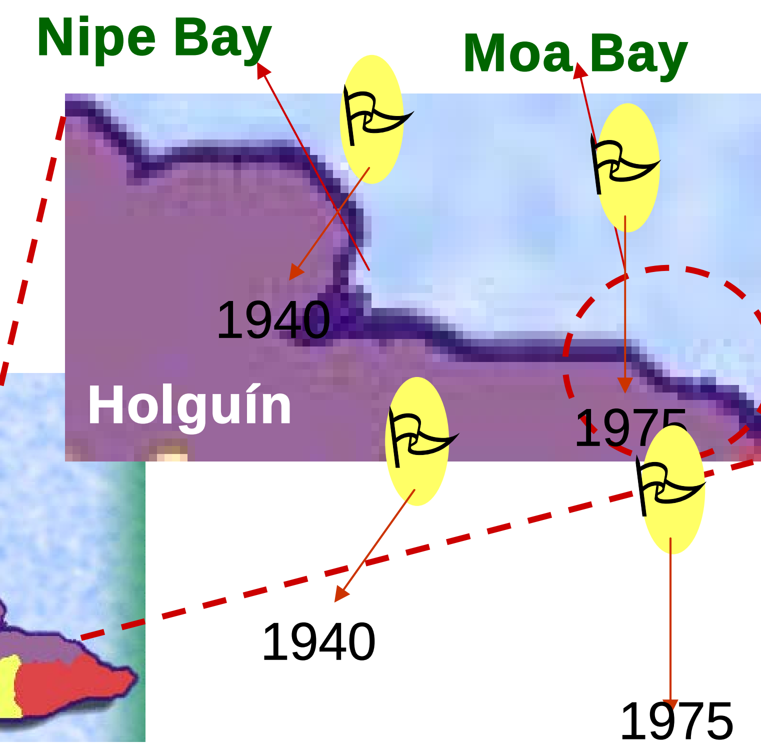


Grade-tonnage diagram for some nickeliferous laterite deposits.

- Cuba has an estimated 37% of the World reserves of Ni.
- Cuba ranks first in the world reserves of Ni and second in world reserves of Co.
- The Ni-ore world production is about 925.000 ton per year.

Hydrometallurgy (carbonate ammonia process) = Oxide–Ni+Co

huge volumes tailing of laterite N (0.25 %) and Co (0.09 %).



Minerales oxidados

- **Bacterias heterotrofica :**

  e.g. *Bacillus*, *Pseudomonas*, *Arthrobacter*

- **Hongos filamentosos:**

  e.g. *Aspergillus*, *Penicillium*

Mecanismo : metal

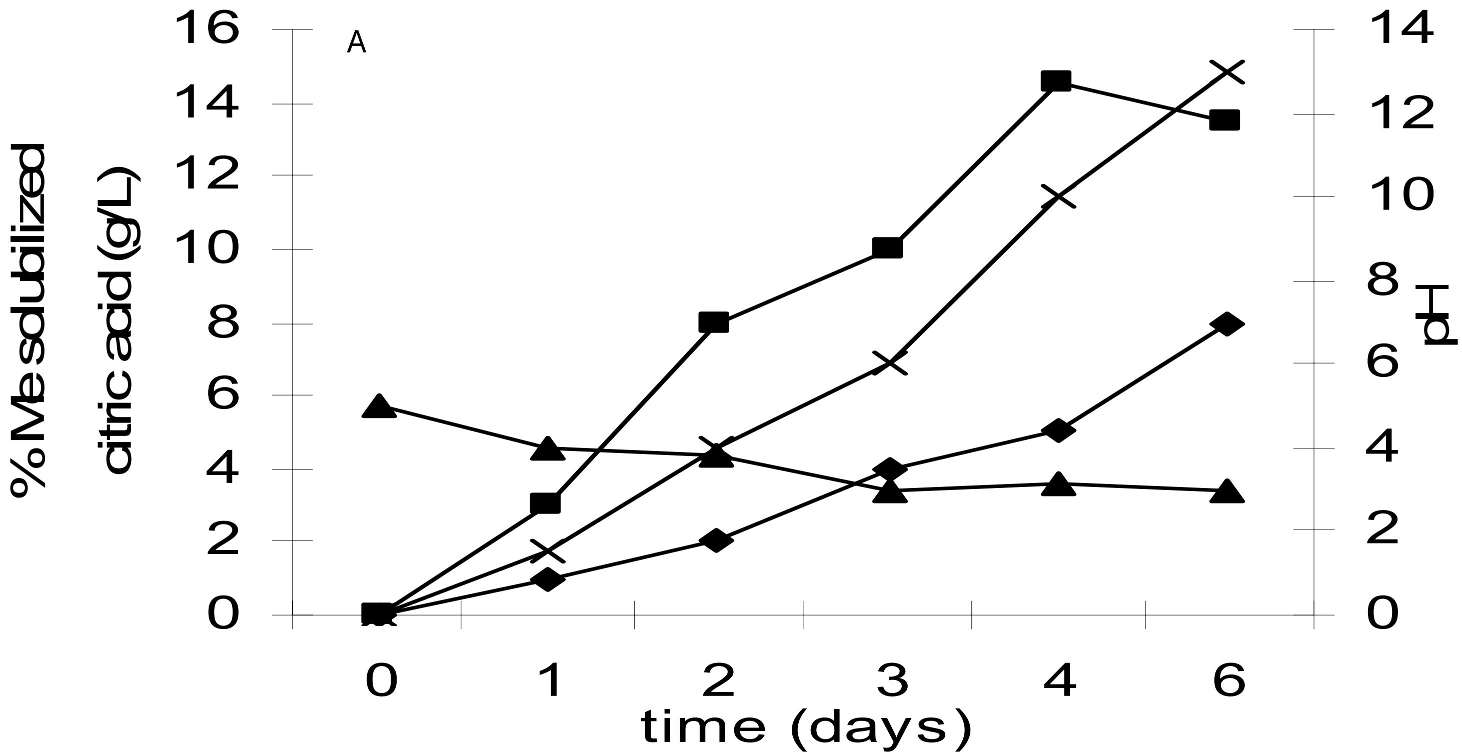
transformation (oxidacion / reduccion)

complejation (acidos organicos)

acidulation (ácidos inorgánico y orgánico)

(Bosecker, 2000)

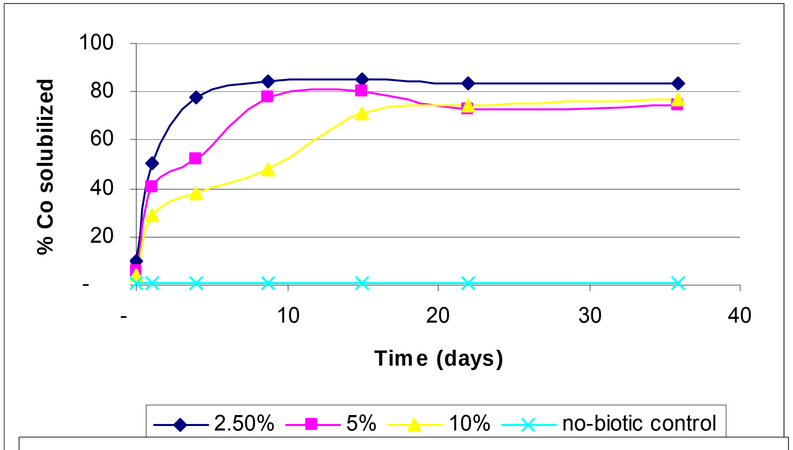
One batch system with *Aspergillus niger O-5*

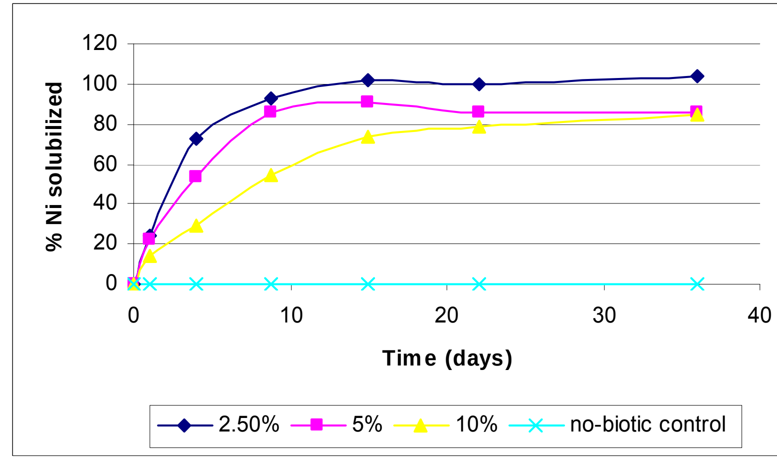


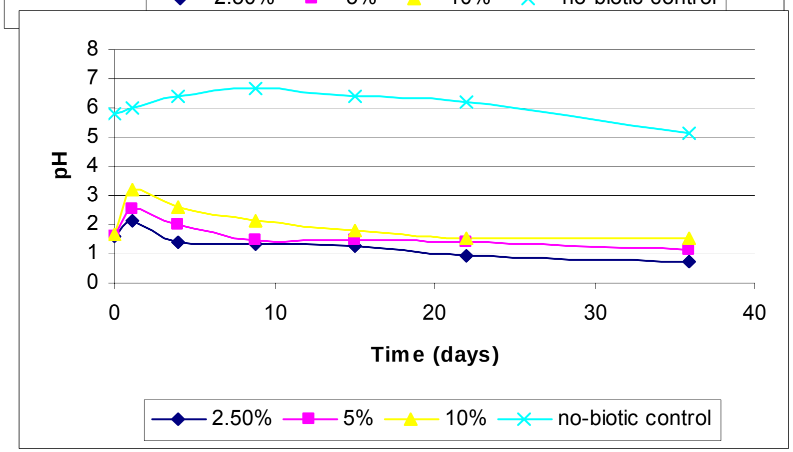
Kinetics of Co and Ni solubilization and pH in one batch system during the biolecahing of laterite tailing (5%) using *Aspergillus niger O-5* cultivated in medium 3, pH 5.5 in shaking conditions (200 rpm) at 30 °C . ■: Co (%), ♦: Ni (%), ▲: pH, x: organic bioacid production

The pH decreased abruptly during the first 3 days of bioleaching. The kinetic of bioleaching was slow. Co began to precipitate after 4 days of bioleaching which indicates loss of cobalt from liquors which could duty to uptake of metal by fungus.

One batch system with *Acidithiobacillus thiooxidans*



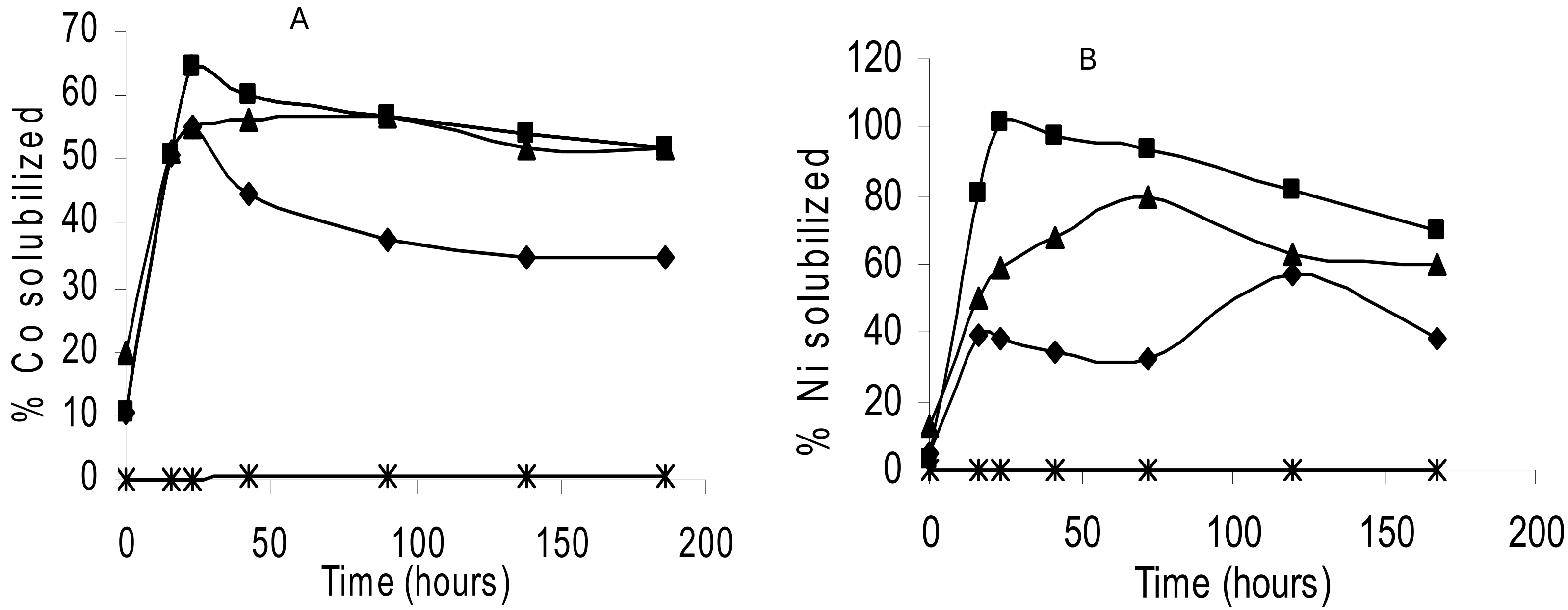




Kinetics of Co and Ni solubilization and pH in one batch system during the biolecahing of laterite tailing . Medium 0K (sulphur 2%), pH 6,0 shaking conditions (100 rpm) at 30 °C during 48 hours. After of this time was added laterite tailings to differents pulp density.

The inorganic bioacid produced by *Acidithiobacillus thiooxidans* “ in situ” was an excelent leaching agent. This allow to obtain high porcentages of solubilization of Ni and Co but with kinetic of reaction slow . The highest recovery of metals was achieved to 2,5 % of pulp density.

Chemical leaching with organic acid and bioleaching in two batch sytem with inorganic acid.



Chemical leaching of Co (A) and Ni (B) using 0.1 M (♦), 0.5 M (■) citric acid and 0.1 M sulphuric bioacid (▲), destilated water as control (x). Pulp density (10%), shaking conditions (200 rpm) at 60 °C . ■: Co (%), ♦: Ni (%), ▲: inoorganic bioacid production

Metal recoveries using chemical leaching with citric acid 0.5 M were highest. (almost of 100 % Ni and 68 % Co. The rate of dissolution of metals with both acids was considerably improved since the energy of reaction is increased with temperature (60^{0}C). In the two-stage process, higher pulp densities (10%)

CONCLUSIONS

The mineralogical composition of raw material is a crucial parameter in the processes of bioleaching of laterite ore. Ni and Co can be leached from laterite tailing using inorganic and organic acid. The sulphuric acid constitute an excellent leaching agent of nickel and cobalt from cuban laterite tailing.

- Metal recoveries in two-stage batch using sulfuric bioacid were higher (79 % Ni and 58 % Co) than those obtained with citric bioacid (2.4 % Ni, and 38 % Co). In both cases is decresed the kinetic of reaction, from days to 16 hours.
- It is shown that citric acid (0.5 M) was the most effective agent of leaching for laterite tailing.
- Citric acid and sulfuric acid could be biogenerate with a considerable decrease of costs of process of bioleching of laterite tailing.

ACKNOWLEDGEMENTS

Cooperación Argentino-Cubana (SECYT-CITMA) bajo la denominación CU/PA04-BVIII/039.

FITORREMEDIACIÓN

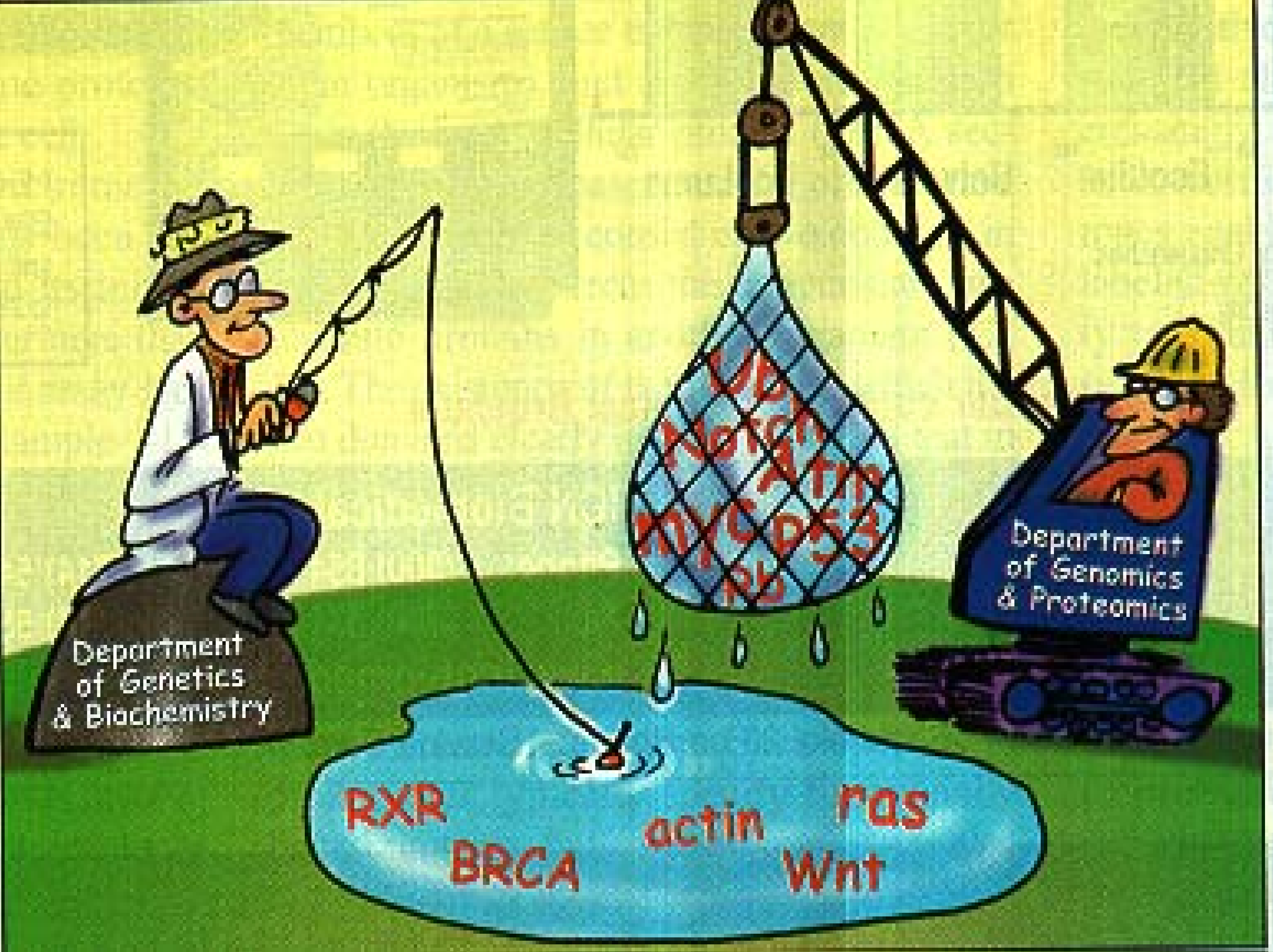
Resultados

- ✓ Se evaluaron en total 22 cepas entre Enterobacterias y *Pseudomonas* aisladas de suelo de serpentinas de las regiones de Cajalba (Pinar del Río), Cubanacán (Villa Clara) y Moa (Holguín), con vistas a seleccionar cepas promisorias para la producción de metabolitos en el control biológico de hongos fitopatógenos.

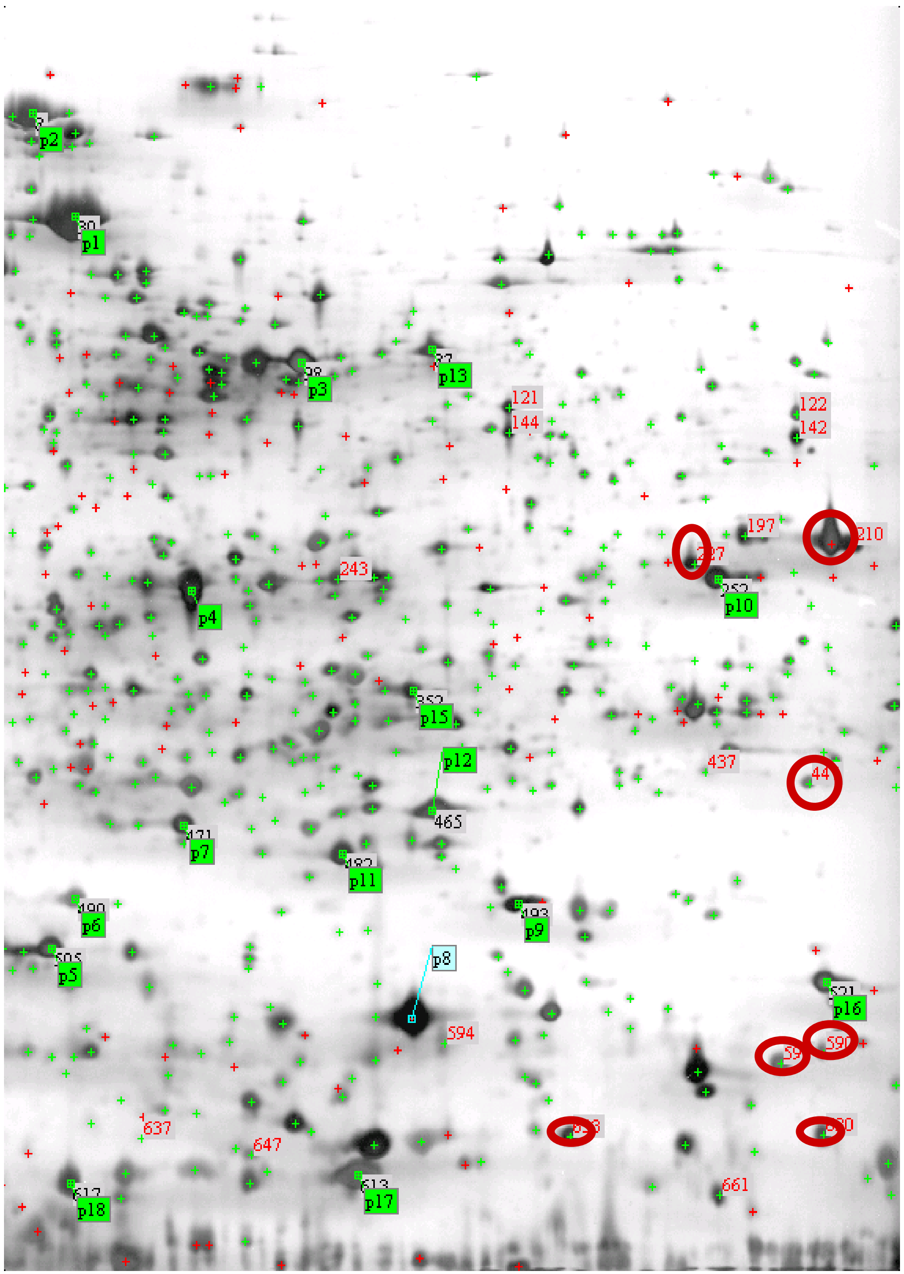
- ✓ Se destacaron 6 cepas antagonistas frente a los hongos *Sclerotium rolfsii* y *Alternaria alternata* (4 *Pseudomonas* y 2 Enterobacterias).

- ✓ Las 6 cepas antagonistas de los hongos estudiados además solubilizan fósforo, presentan resistencia a níquel, producen polihidroxialcanoato (PHA), tienen actividad fosfatasa ácida y resistencia a los antibióticos kanamicina, ampicillina, tetraciclina y cloranfenicol. Atributos que favorecen la colonización de plantas hiperacumuladoras de metales. .

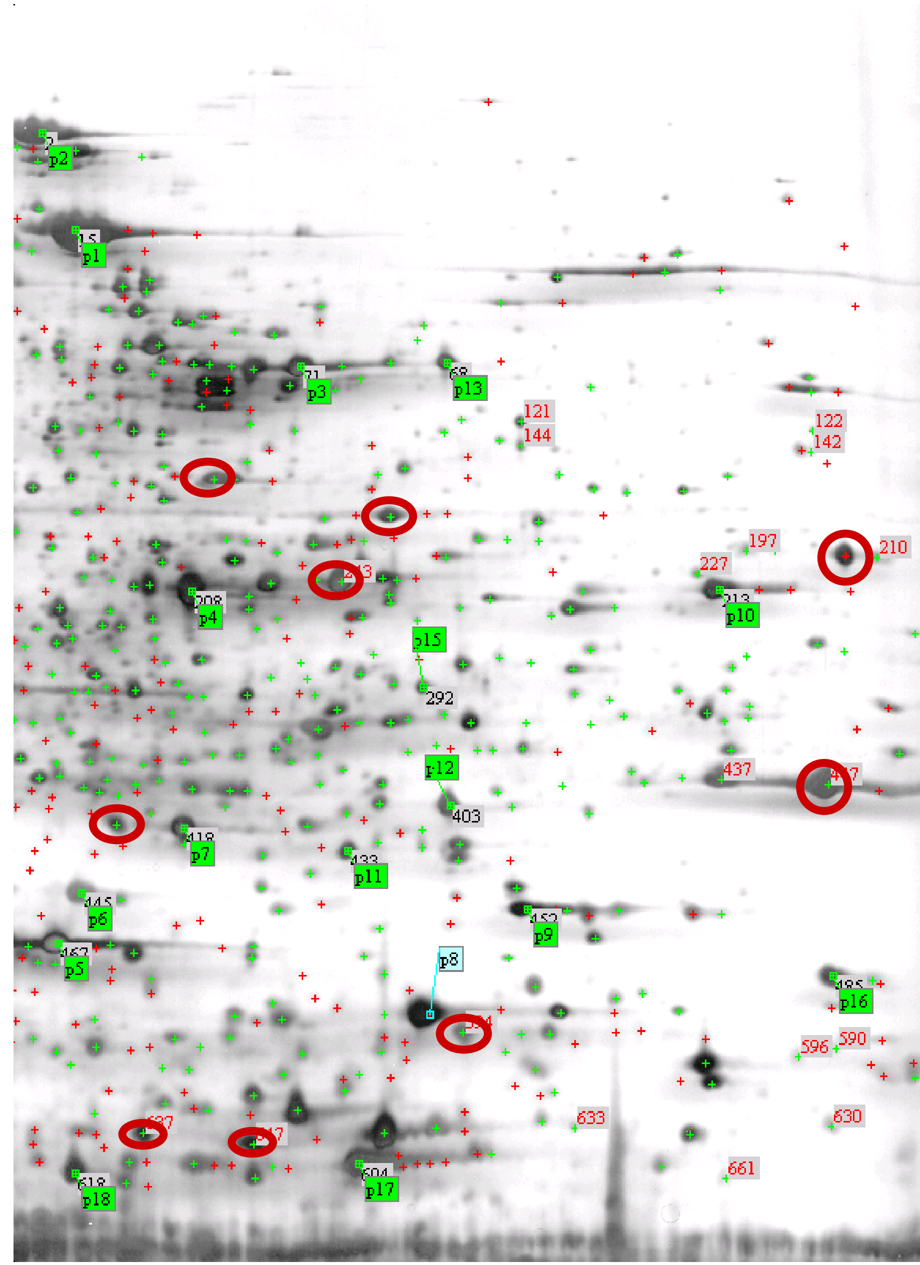
ESTUDIO MOLECULAR DE UNA BACTERIA ALTAMENTE RESISTENTE A COBALTO.


Department of Genetics & Biochemistry
Department of Genomics & Proteomics
RXR
BRCA
actin
ras
Wnt

Serie C



Serie E



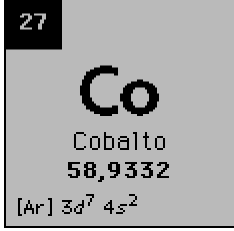
Co (II)

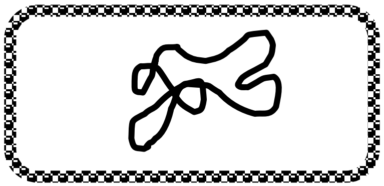
↓

Unbalance in the cellular redox status

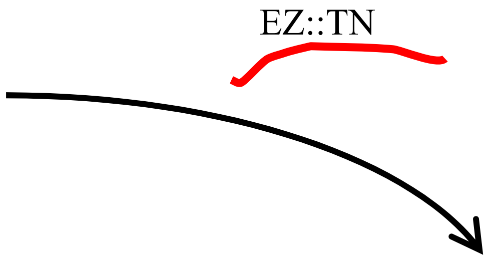
Marrero J, et al., *Proteomics*, 2004;4(5):1265-79.

Aislamiento y caracterizacion de mutantes sensibles a Ni/Co mediante mutagenesis con transposon

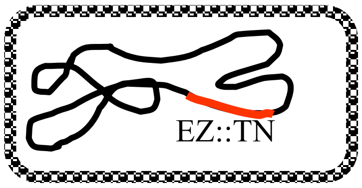




cepa C-1



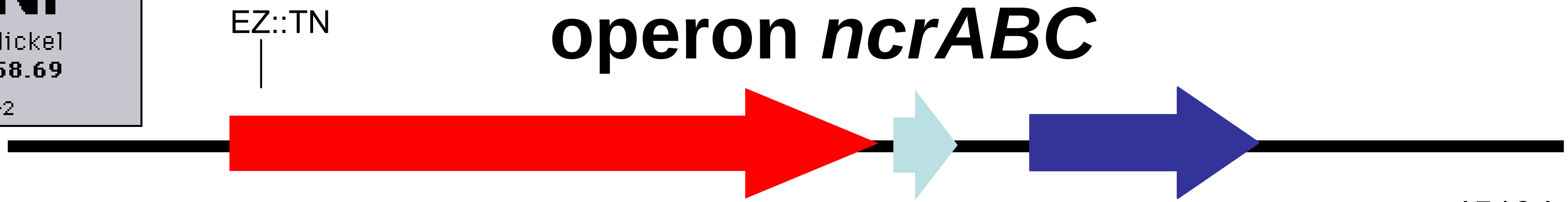
EZ::TN <R6Kγori/KAN-2> Tnp estuche de transposoma

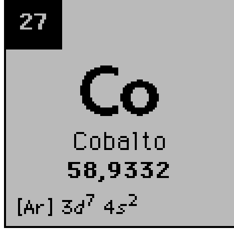


>3500 Derivados de insercion

10 mutantes sensibles a Ni/Co mediante plaqueo por replica

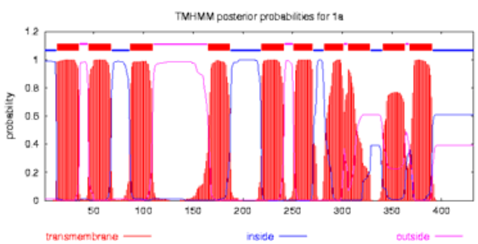
operon *ncrABC*

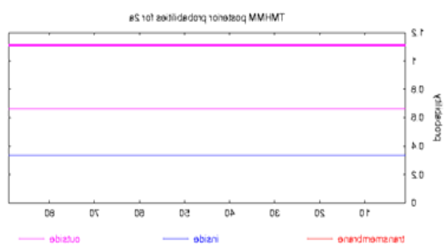


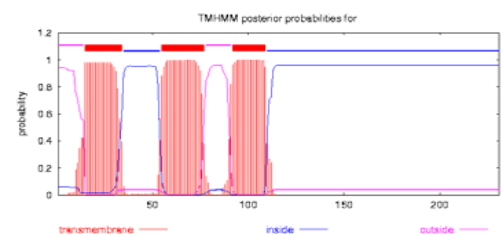


***ncr*A** **ncrB** ***ncr*C**

4519 bp
NCBI: DQ472000







- Proteína de membrana
- 432 aa
- C-terminal - His

- Proteína pequeña rica en His
- 89 aa
- proteína regulatoria del determinante *ncr*

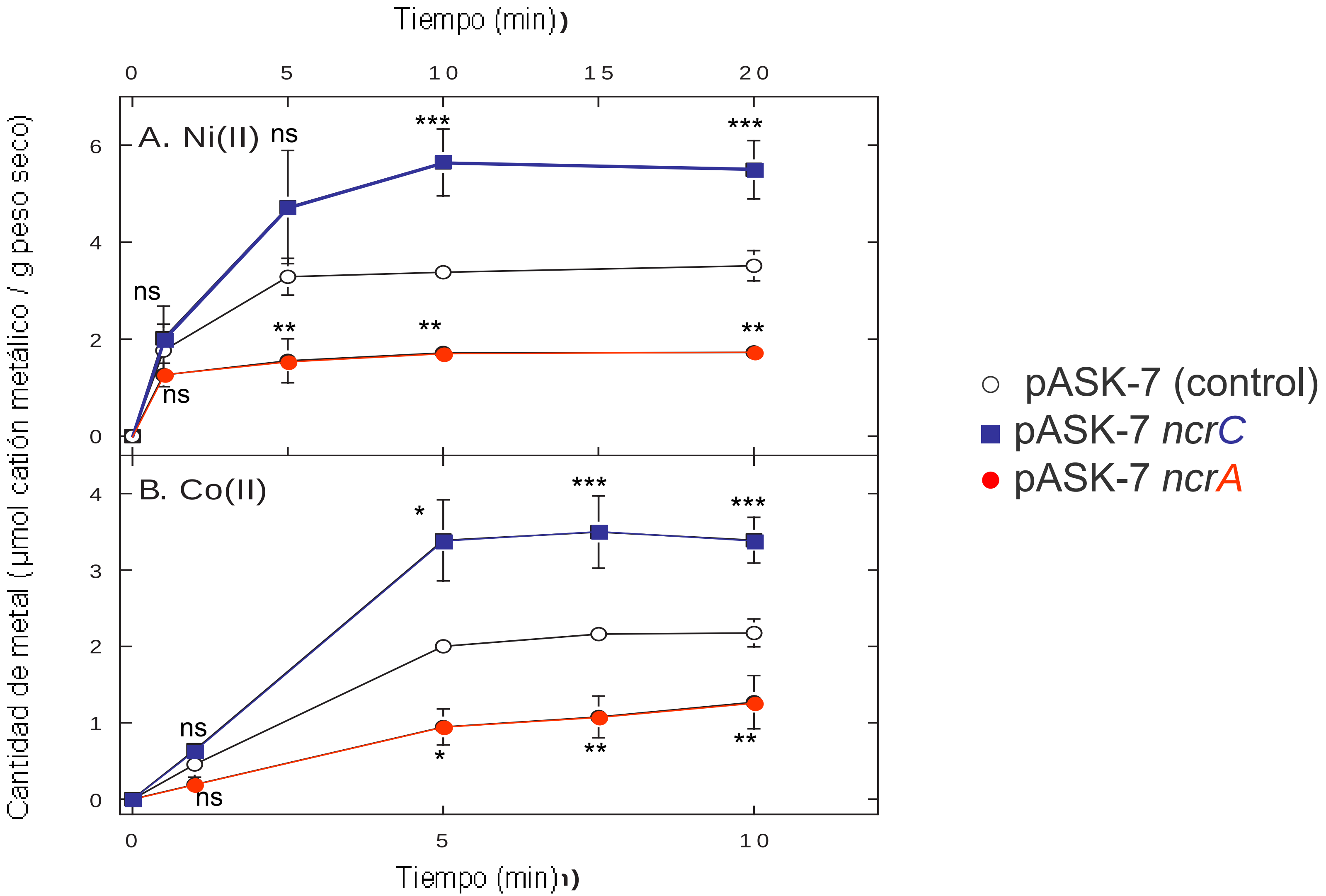
- Proteína de membrana
- 232 aa
- la mitad de C-terminal - His

28
Ni
Nickel
58.69
2-8-16-2

4 TAREA

Resistencia a Co II y Ni II de las cepas de *E. coli* que contienen los genes *ncr*

27
Co
Cobalto
58,9332
[Ar] $3d^7$ $4s^2$



Marrero J, et al., *Molecular Ecology*, 2007; 53(1):123 - 133 .