



US009340849B2

(12) **United States Patent**  
**Robertson et al.**

(10) **Patent No.:** **US 9,340,849 B2**  
(45) **Date of Patent:** **May 17, 2016**

(54) **SYSTEMS AND METHODS FOR METAL RECOVERY**

(71) Applicant: **FREEMPORT-McMORAN CORPORATION**, Phoenix, AZ (US)

(72) Inventors: **Joanna M Robertson**, Thatcher, AZ (US); **Thomas R Bolles**, Tucson, AZ (US); **Wayne W Hazen**, Lakewood, CO (US); **Lawrence D May**, Westminster, CO (US); **Jay C Smith**, Pearl River, LA (US); **David R Baughman**, Golden, CO (US)

(73) Assignee: **FREEMPORT MINERALS CORPORATION**, Phoenix, AZ (US)

(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 185 days.

(21) Appl. No.: **13/716,836**

(22) Filed: **Dec. 17, 2012**

(65) **Prior Publication Data**

US 2013/0153436 A1 Jun. 20, 2013

**Related U.S. Application Data**

(60) Provisional application No. 61/577,995, filed on Dec. 20, 2011.

(51) **Int. Cl.**

**C22B 1/02** (2006.01)  
**C22B 23/00** (2006.01)  
**C25C 1/00** (2006.01)  
**C22B 3/02** (2006.01)  
**C22B 3/14** (2006.01)  
**C22B 3/12** (2006.01)  
**C25C 1/12** (2006.01)  
**C25C 7/02** (2006.01)

(52) **U.S. Cl.**

CPC ... **C22B 1/02** (2013.01); **C22B 3/02** (2013.01); **C22B 3/12** (2013.01); **C22B 3/14** (2013.01); **C22B 23/005** (2013.01); **C25C 1/00** (2013.01); **C25C 1/12** (2013.01); **C25C 7/02** (2013.01); **Y02P 10/234** (2015.11)

(58) **Field of Classification Search**

None  
See application file for complete search history.

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

1,440,186 A \* 12/1922 Perkins et al. .... 423/33  
1,825,949 A \* 10/1931 Haas ..... 423/33  
2,576,314 A \* 11/1951 Forward ..... 423/141  
2,693,404 A \* 11/1954 Mackiw ..... 423/32  
4,187,281 A \* 2/1980 Stauter ..... 423/150.3  
6,524,367 B1 \* 2/2003 Castellanos Suarez et al. .... 75/425  
2007/0248514 A1 \* 10/2007 Cheng et al. .... 423/139

**FOREIGN PATENT DOCUMENTS**

CA 2732486 A1 \* 9/2011  
IN 187882 B \* 7/2002  
WO WO 2004035840 A1 \* 4/2004  
ZA 200204434 A \* 4/2003

\* cited by examiner

*Primary Examiner* — Melissa Swain

(74) *Attorney, Agent, or Firm* — Snell & Wilmer L.L.P.

(57) **ABSTRACT**

Various embodiments provide a process roasting a metal bearing material under oxidizing conditions to produce an oxidized metal bearing material, roasting the oxidized metal bearing material under reducing conditions to produce a roasted metal bearing material, and leaching the roasted metal bearing material in a basic medium to yield a pregnant leach solution.

**11 Claims, 2 Drawing Sheets**

