



## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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| <p>(51) International Patent Classification <sup>7</sup> :<br/><b>G01V 1/40</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>A1</b> | <p>(11) International Publication Number: <b>WO 00/60379</b></p> <p>(43) International Publication Date: <b>12 October 2000 (12.10.00)</b></p> |
| <p>(21) International Application Number: <b>PCT/US00/08761</b></p> <p>(22) International Filing Date: <b>31 March 2000 (31.03.00)</b></p> <p>(30) Priority Data:<br/>             09/285,570                      2 April 1999 (02.04.99)                      US<br/>             09/399,218                      17 September 1999 (17.09.99)                      US<br/>             09/405,850                      24 September 1999 (24.09.99)                      US</p> <p>(71) Applicant: <b>CONOCO, INC. [US/US]; 1000 South Pine Street, P.O. Box 1267, Ponca City, OK 74602-1267 (US).</b></p> <p>(72) Inventors: <b>HUFFMAN, Alan, Royce; 2304 Copperfield Circle, Ponca City, OK 74604 (US). JORGENSEN, Gregory, Joseph; 3009 Turner Road, Ponca City, OK 74604 (US). KISABETH, Jerry, Lee; 300 North 10th, Ponca City, OK 74601 (US). SINTON, John, B.; 200 Michael Lane, Ponca City, OK 74604 (US). BELL, David, W.; 5 Hillcrest, Ponca City, OK 74604 (US).</b></p> <p>(74) Agent: <b>SRIRAM, Kaushik, P.; Madan, Mossman &amp; Sriram, P.C., Suite 700, 2603 Augusta, Houston, TX 77057 (US).</b></p>                                                                                                                                                                                                                                     |           |                                                                                                                                                |
| <p>(81) Designated States: <b>AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).</b></p> <p><b>Published</b><br/> <i>With international search report.<br/>         Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |           |                                                                                                                                                |
| <p>(54) Title: <b>A METHOD FOR GRAVITY AND MAGNETIC DATA INVERSION USING VECTOR AND TENSOR DATA WITH SEISMIC IMAGING AND GEOPRESSURE PREDICTION FOR OIL, GAS AND MINERAL EXPLORATION AND PRODUCTION</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |           |                                                                                                                                                |
| <p>(57) Abstract</p> <p>A method for modeling geological structures includes obtaining seismic data, (12), and using this data to derive an initial density model, (14). Potential field data is used to update the initial geophysical model by an inversion process using vector or tensor components of gravity or magnetic data, (46). Potential field data is used to derive the lower boundary of the anomalous density zones by using an inversion process derived from the initial model of the top topographic or bathymetric surface with the 2D or 3D density model including any zones of anomalous density, (44). The final density model from the inversion may be further refined using the seismic data in conjunction with the model obtained by inversion of the potential fields data. The model data are integrated two or three dimensions to determine an overburden stress-for the sub-surface that includes a proper treatment of the anomalous density zone. The seismic data can be processed in depth or time using the density model from the inversion to improve the quality of the velocity information adjacent to the anomalous bodies. The velocity measurements are used to determine the effective stress and the fluid pressure is obtained as the difference between the overburden stress and the effective stress.</p> |           |                                                                                                                                                |
| <pre> graph TD     12[12 Receive Seismic Data] --&gt; 14[14 Derive Model Top]     14 --&gt; 16[16 Receive Data for Lower Boundary]     16 --&gt; 18[18 Set Limits for Lower Boundary]     18 --&gt; 20[20 Predict First Coefficient]     20 --&gt; 22[22 Add Coefficient]     22 --&gt; 24[24 Adjust Prior Coefficients]     24 --&gt; 26{26 Final Coefficient?}     26 -- No --&gt; 22     26 -- Yes --&gt; 34[34 Transfer Final Model to Seismic]     34 --&gt; 36[36 Update Seismic Velocity]     36 --&gt; 38[38 Perform Depth Imaging]     38 --&gt; 40[40 Interpret Reflection From Base]     40 --&gt; 42[42 Compare New Base to Old]     42 --&gt; 44{44 Models Agree?}     44 -- No --&gt; 46[46 Update GMI Model]     46 --&gt; 20     44 -- Yes --&gt; 48[48 DISPLAY]   </pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |           |                                                                                                                                                |