Progress report on: Start of a PhD on the improved interpretation of combined EM and seismic data

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1 Executive Summary (restricted)

In the CATO-2a “Beschikking” (AD-01), the following deliverable is mentioned:

- Progress report on: Start of a PhD on the improved interpretation of combined EM and seismic data.

The originally 5 year CATO-2 Program has been divided in CATO-2a (first year) and CATO-2b (second till fifth year). Since the funding for CATO-2b was not guaranteed, universities were not allowed to make a four-year commitment for a PhD. Therefore, the progress on this subject is limited to the PhD description.

Distribution List

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Document Change Record

(this section shows the historical versions, with a short description of the updates)

Version	Nr of pages	Short description of change	Pages
1	See header	First version	

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2 Applicable/Reference documents and Abbreviations

2.1 Applicable Documents

(Applicable Documents, including their version, are documents that are the "legal" basis to the work performed)

	Title	Doc nr	Version date
AD-01	Beschikking (Subsidieverlening CATO-2 programma verplichtingnummer 1-6843	ET/ED/9078040	2009.07.09
AD-02	Consortium Agreement	CATO-2-CA	2009.09.07
AD-03	Program Plan	CATO2-WP0.A-D.03	2009.09.29

2.2 Reference Documents

(Reference Documents are referred to in the document)

	Title	Doc nr	Issue/version	date

2.3 Abbreviations

(this refers to abbreviations used in this document)

3 PhD description

PhD/Postdoc WPnr + Deliverable nr + thesis title	PhD WP3.07 D06 **Combined Seismic and EM for 3D monitoring**
Version date	2010.08.20
Promotor + University	Prof.dr.ir. C.P.A.Wapenaar, Delft University of Technology
Objective	Optimizing the combination of seismic and EM methods for CO_2 monitoring, based on models and data from the site chosen for CO_2 monitoring
Description of Work	Changes in the subsurface due to natural or human causes are usually very subtle, and therefore also in the case of CO2-monitoring. A requirement for the 3D monitoring techniques is that they need to be very repeatable over time, and this is particularly the case for monitoring on land. Time-lapse seismic methods have become now rather standard for subsurface monitoring, also for CO_2 monitoring (like in, e.g., the Sleipner field). Permanent 3D monitoring is an added step which allows better repeatabilities which is specifically a necessity for monitoring on land. Permanent monitoring focussed only on seismic methods is addressed in deliverable D05 of this same work package. Over the last years, controlled-source electro-magnetic (CSEM) methods have become more attractive in the field of 3D reservoir monitoring. Although the method, its sensitivities and repeatabilities are still part of ongoing research, the method has the potential to be used for 3D monitoring of the subsurface. The feasibility of such EM methods is addressed by the feasibility study as carried out under deliverable D01 of this same work package. Both the seismic and the (CS)EM methods have their advantages. While seismic methods obtain detailed structural information and low-strain mechanical properties, they have low sensitivity to the changes in properties due to CO_2 injection, also depending on the phase that CO_2 will be residing in the reservoir, being gas-filled or water-filled. EM methods are (very) sensitive to the property-changes due to CO_2-injection, but their spatial resolution is very limited. In this work we will investigate how these two methods can be optimally combined, taking into account their different strengths and sensitivities. An obvious combination is to take the structural information obtained from the seismic into account in the EM inversion. But also to take the EM information into account as a constraint in the seismic inversion. Another combination is to use the results of the lab-type petrophysical experiments (as performed in work package 3.08) on both seismic and EM as constraints in the combined inversion. How to do that in a proper way will be part of the work envisaged. All the scenarios for the above will be based on the specific site chosen for the CO_2-monitoring in CATO2. Finally, the developed approach will be used for the real data as obtained for the chosen CATO2-monitoring site in the Netherlands. (This work will be done in cooperation with the TUDelft EM-expert Dr.ir. E.C. Slob)