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A Collaborative Workflow-Oriented Environment to Capture and Reuse Technical Knowledge in a Reservoir Characterization Workflow

Abstract

The paper describes the approach adopted by Eni E&P Division to provide E&P professionals with a Web-based collaborative environment where technical know-how can be easily captured and reused along all phases of an E&P project. The paper specifically focuses on a case study related to the reservoir characterization workflow.

The environment provides the functionality needed to access the different types of technical data and information that are relevant to each phase of the project, and to quickly consolidate the results and transform them into company knowledge.

In the first phase of a reservoir characterization workflow, the focus is on finding all the information relevant to the asset under study. This includes reports and project databases from prior studies, updated seismic interpretation models, data from new wells. This can be considered as the available "asset knowledge" and it is retrievable through integrated searches across both traditional Oracle databases and document management systems.

In the subsequent phases, the interpretation process is started. The environment provides tools to access the best available "professional knowledge" to carry out the work. This can be achieved by leveraging collaborative work sessions with geographically distributed experts, as well as by using powerful semantic search tools to find out the best approaches used in similar studies.

Finally, the environment allows the automatic capture and indexing of the generated interpretation data and reporting documents for later reuse. This includes the consolidation of the lessons learnt from the project into "workflow knowledge". The environment automatically instantiates a live "best practice" for reservoir characterization for any future project.

Introduction

Within a reservoir characterization project, the term "knowledge" can have different meanings depending on the specific process phase we are dealing with. In the initial phases of a project, it could mean "collection of the available datasets and documents for the asset under study"; in following phases, it could mean the possibility of searching an horizontal (discipline or domain-specific) knowledge base of "professional expertise", as well as the possibility of "involving a geographically distributed network of experts" to support key steps in the interpretation process. Within ENI E&P, a specialized collaborative environment has been designed so that each E&P professional can leverage the most appropriate methods and tools to gain access to the "knowledge" they need for each specific project phase. The environment has been named "The Technical Know How Portal".

Background technology

The overall environment is based on the "Web Workspace" emerging technology [1]. Such technology supports the possibility of using a Web page on the PC to perform integrated searches on both datasets and documents stored in
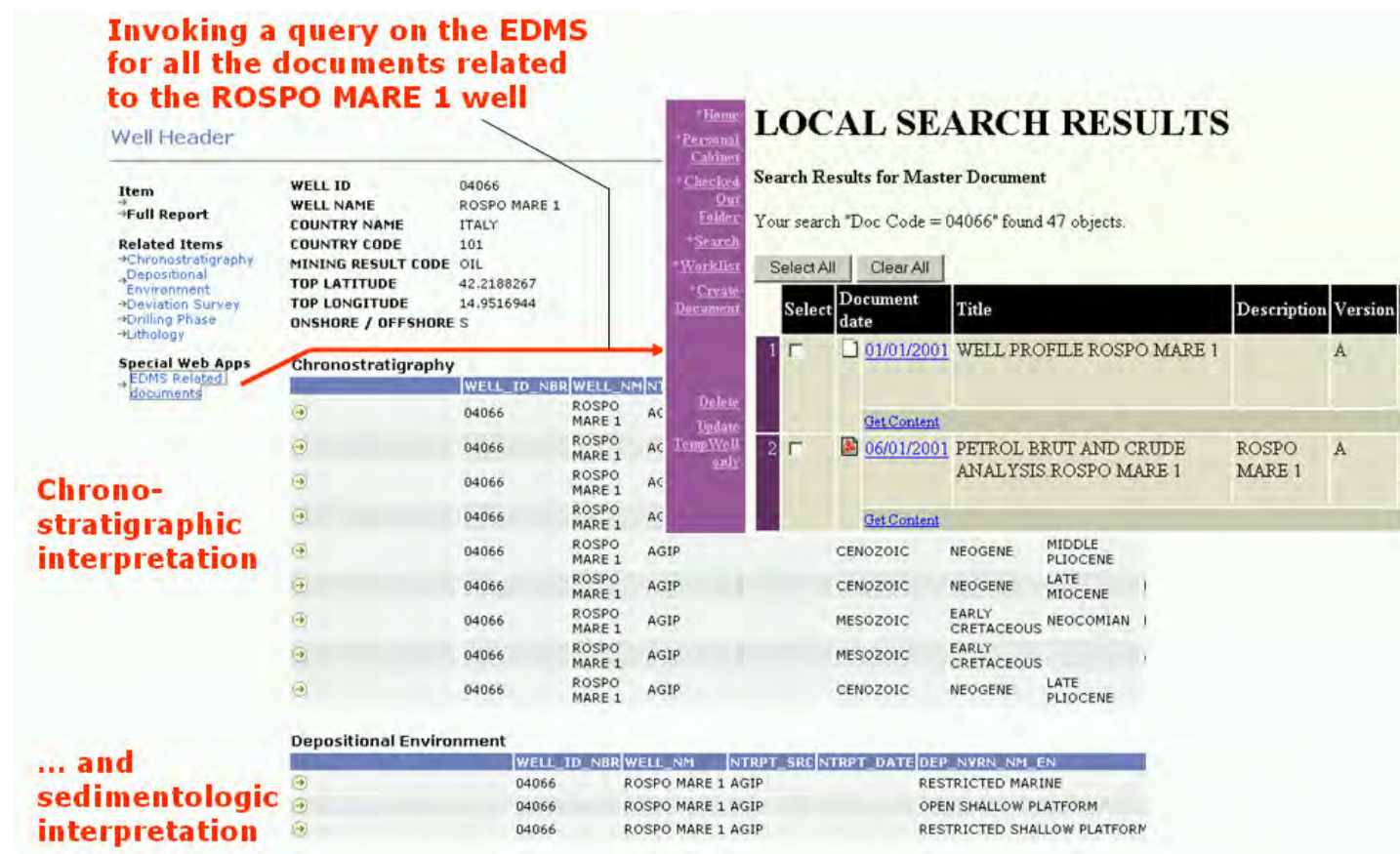
Fig. 1

heterogeneous databases across a geographically distributed organization, as well as the possibility of invoking UNIX and PC based applications from a remote server, without the need of having them installed in the local organization. Fig. 1 shows an example of using the Web Workspace technology to display, for a given well within ENI E&P master database, all the available interpretations (chronostratigraphy and depositional environments) together with all the available reports of the well under study.

Overview of the environment

Fig. 2 shows how the environment is designed. The reservoir geologist is presented a typical sequence of steps that are followed when dealing with a reservoir characterization workflow. The figure shows the workflow of the "Integrated Study" project. Each step is displayed with a different symbol and colour according to its completion status, from red (still to be started) to green (completed). Moreover, each project is associated with the main E&P objects it refers to, e.g. countries, lease, fields, wells (see right part of the figure).

When clicking on each step, a complete working environment is opened to support the specific phase of the project (fig. 3).

Asset and Workflow Knowledge

In the initial data gathering phase, a key issue is to collect all the available information about the area under study. This includes previous reservoir studies that have been stored and indexed in the company Electronic Document Management System (EDMS); regional studies performed at the basin scale; data collected from third party databases; new data from wells that have been drilled after the previous reservoir study; the updates in the seismic
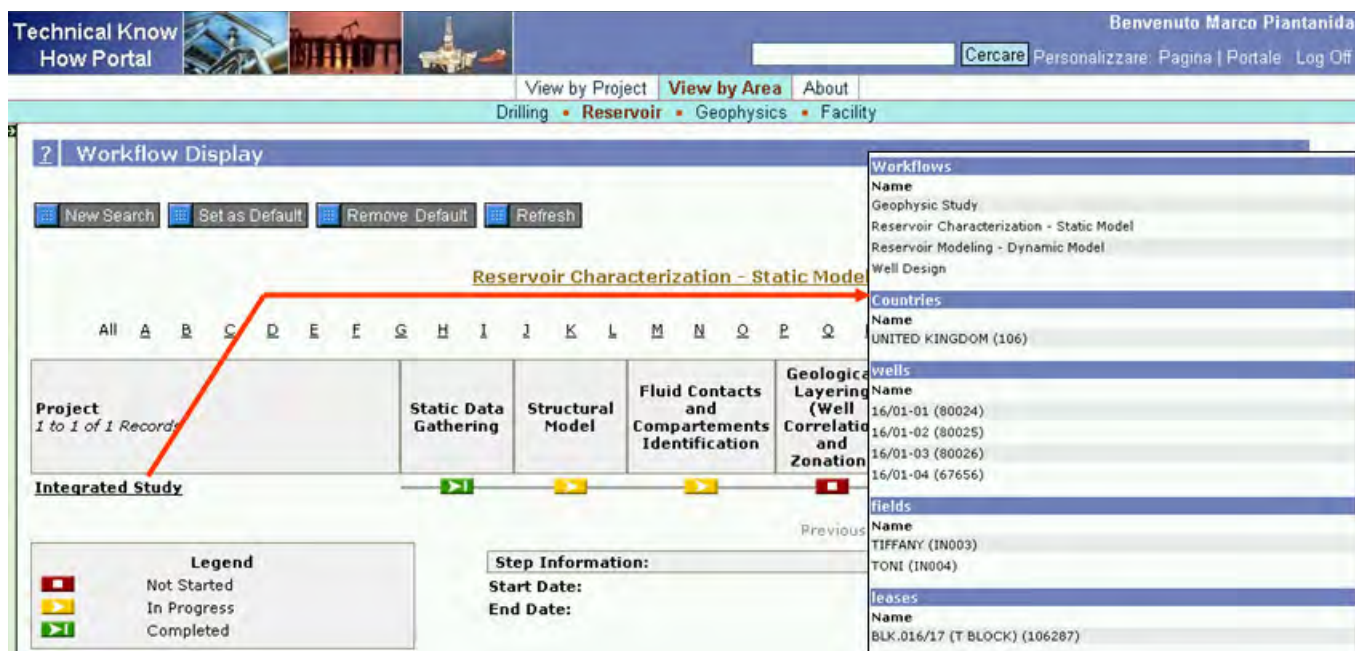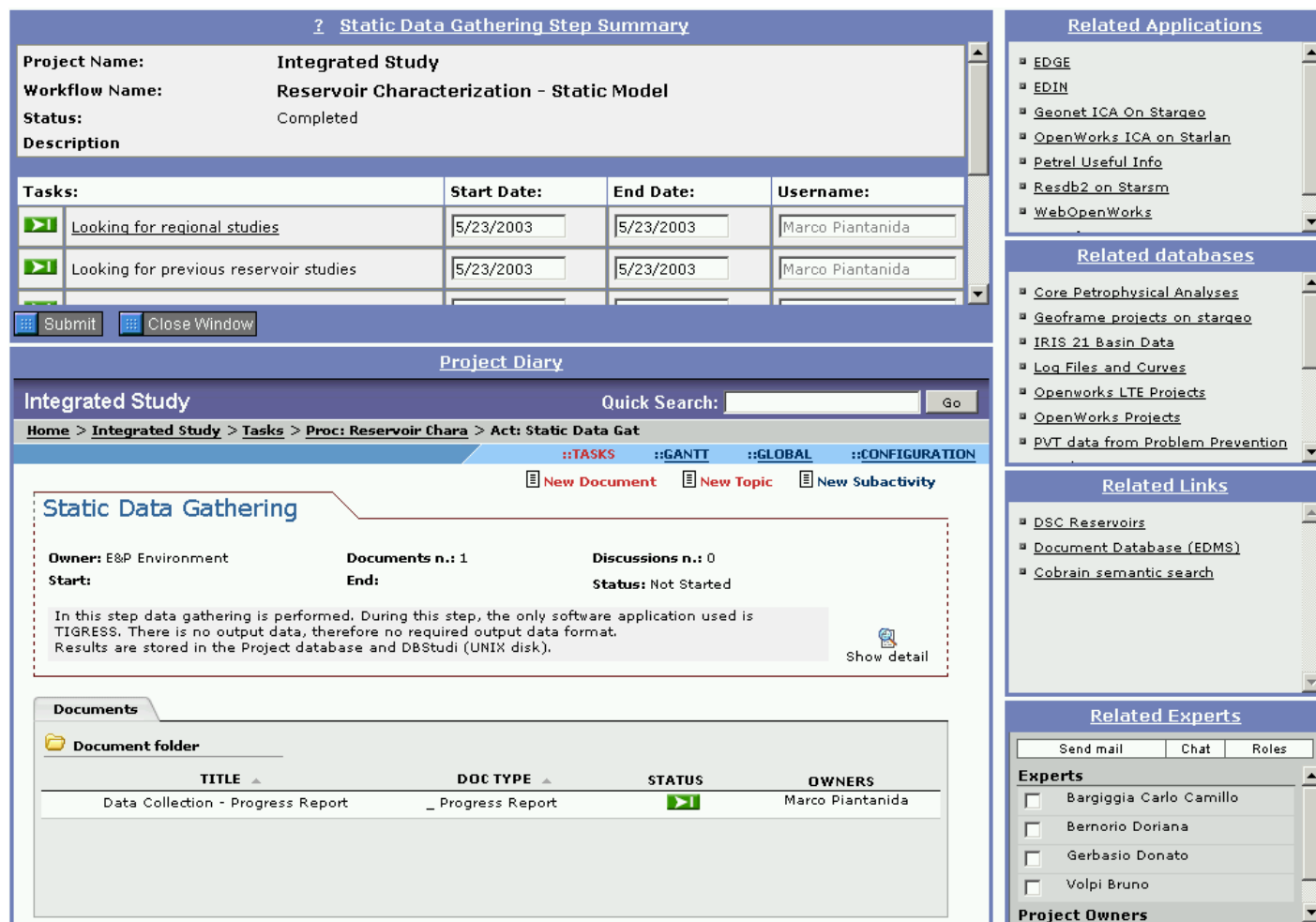
Fig. 2

Fig. 3

Fig. 4

interpretation project. Each of these data sets is stored in different databases (e.g. EDMS, IHS IRIS 21, C&C reservoirs Analogue Database, the company Well Database, Geoframe and Openworks project databases), each incorporating their own proprietary navigation tools. Querying each database and integrating the results is a task that requires skills and time, which are often unavailable. The total amount of information collected in this phase can be considered as the most important part of the knowledge we have about the asset under study ("asset knowledge").

Fig. 3 shows how, in the upper left part of the screen, the user is guided with a "task list" to gain the best understanding (i.e. knowledge) of the area under study before moving to the interpretation part of the project. The task list is more than just a reminder for the user, it is actively linked to information sources required to carry out the task. Fig. 4 shows how clicking on the first task automatically invokes a query on the EDMS, returning all the relevant "Regional Studies" documents for the country associated with the specific project ("Tunisia" in the example). The geologist does not need to be aware of the location of the EDMS and of the tools and syntax that are used to query the EDMS for documents.

The right part of the window can be used to invoke applications and access databases which could be useful for the specific step. Fig. 5 shows how the IRIS 21 database can be queried for basin data. The query looks quite similar to the one issued on the master database within ENI E&P (see fig. 1), despite the fact that a completely different database is being queried. A specialized application provided by the vendor (IHS EDIN in the figure) can then be invoked to display all the details of the basin under consideration.

Fig. 5

For each project that includes a reservoir characterization workflow, this ability to specify the best way to perform each operation can be considered "workflow knowledge", i.e., a "live" best practice to be followed to achieve the best results in the specific step.

Professional Expertise

Other phases may require different types of knowledge to be accessed. For example, in the petrophysical characterization step, the specific task "Cluster analysis process and validation" may require the interaction with an expert in a different geographic location. Fig. 6 shows how an UNIX application (e.g. Tigress, in the left part of the figure) can be invoked from the Web page, regardless of the geographic location where it is installed; several users can concurrently contribute to the overall interpretation. Another task, "Data analysis (quality and consistency check)" may require that, due to lack of data for key reservoir parameters, the reservoir geologist needs to infer sound values for the unknown parameter from an analogue searched on a worldwide base. The central-lower part of fig. 6 shows the activation of an innovative analogue search tool based on case based reasoning concepts [2], which was developed as an internal R&D project within ENI E&P and is made available from the appropriate step of the workflow.

Another key issue is the possibility to jointly develop a shared document, describing the results of the interpretation process. The lower left part of the environment shown in fig. 3 provides a collaborative environment for document
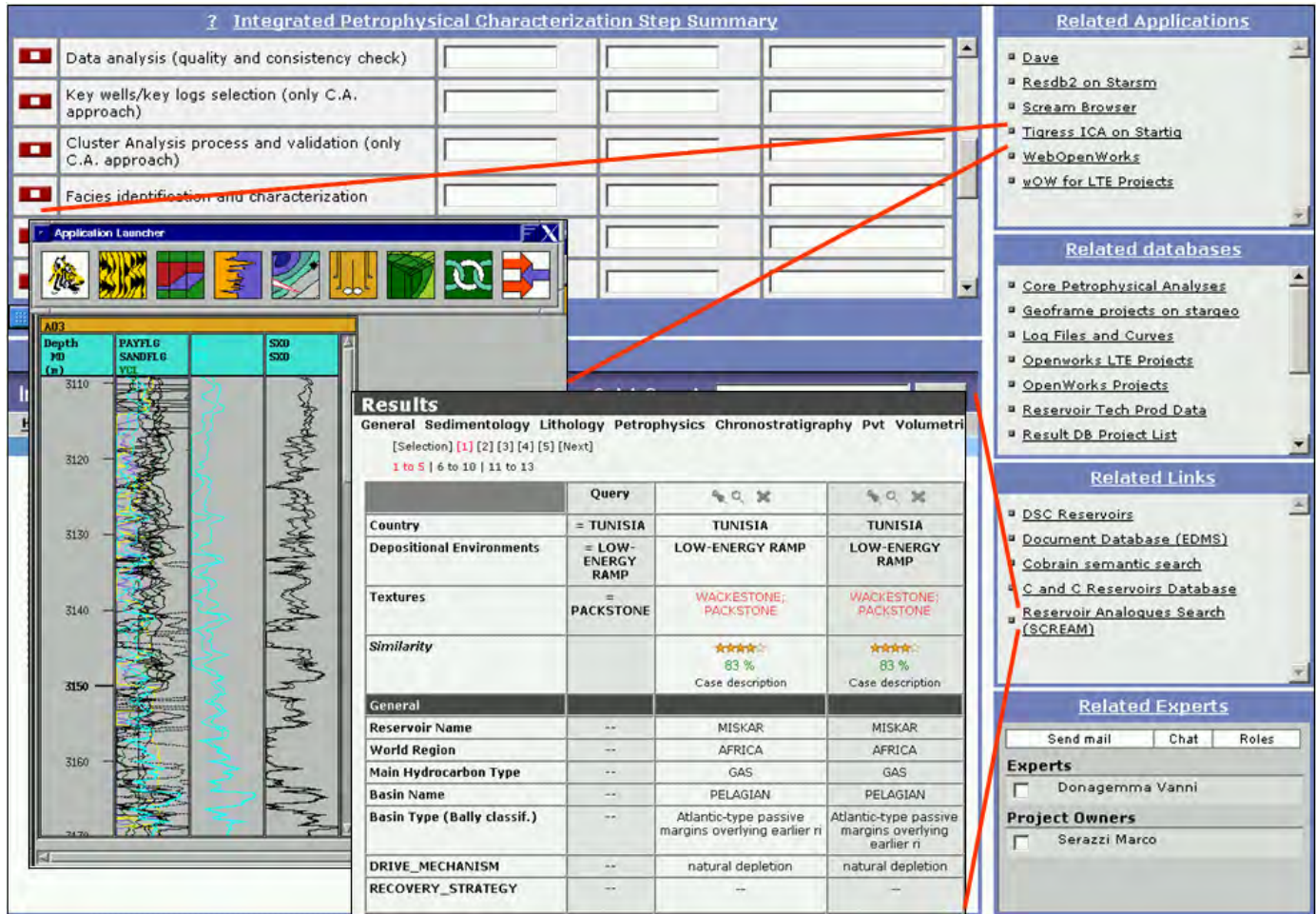
Fig. 6

sharing. When a document is modified, an automatic notification mechanism informs all the interested E&P professionals about the modification. Moreover, each document is automatically annotated with the key E&P objects it refers to (fig. 7). This allows for a quick storage of the document into the company EDMS, from where it will be available for retrieval in a "Data gathering" phase of a future project.

Finally, the same capability to look for analogues can be leveraged for unstructured documents by using the new generation of semantic search engines. These engines are able to understand the inner structure of sentences (fig. 8) for subjects, verbs and objects. This allows for expressing queries such as: "what is the possible effect of dolomitization on a reservoir?". This type of query will analyse all the documents where "dolomitization" is the subject and "reservoir" is the object, therefore reducing the result set to those documents which are really pertinent to the request of the user. The example is based on Invention Machine's Cobrain search tool.

The examples fully describe how "professional expertise" can be accessed from each step where it is needed, in the form of either thematic databases for the reservoir professionals, or collaborative sessions for achieving the best interpretation results.

Conclusions

The collaborative environment described in the paper is a key part of the overall ENI E&P strategy for the capture, retention and reuse of technical knowledge [3]. It allows the integration of the most suitable tools and methods for

Fig. 7

each specific phase of an E&P project. It has been achieved with an original integration of: a Web Workspace environment (Landmark's Team Workspace) which provides the underlying technology for database access and application invocation; a collaborative document management system (IBM Lotus Domino) and synchronous collaboration tool (IBM Lotus Sametime); and a workflow-oriented knowledge environment (Accenture EandP Online) which glues everything together. The Technical Know How Portal is being released this year throughout the ENI organization. The initial reaction of the users is positive: they had been used to perform collaborative sessions on documents since 1999, and they are now appreciating the new functionalities introduced by the portal. A set of key users has been identified to continuously enhance the content of the portal and to act as focal points for the overall population of users.
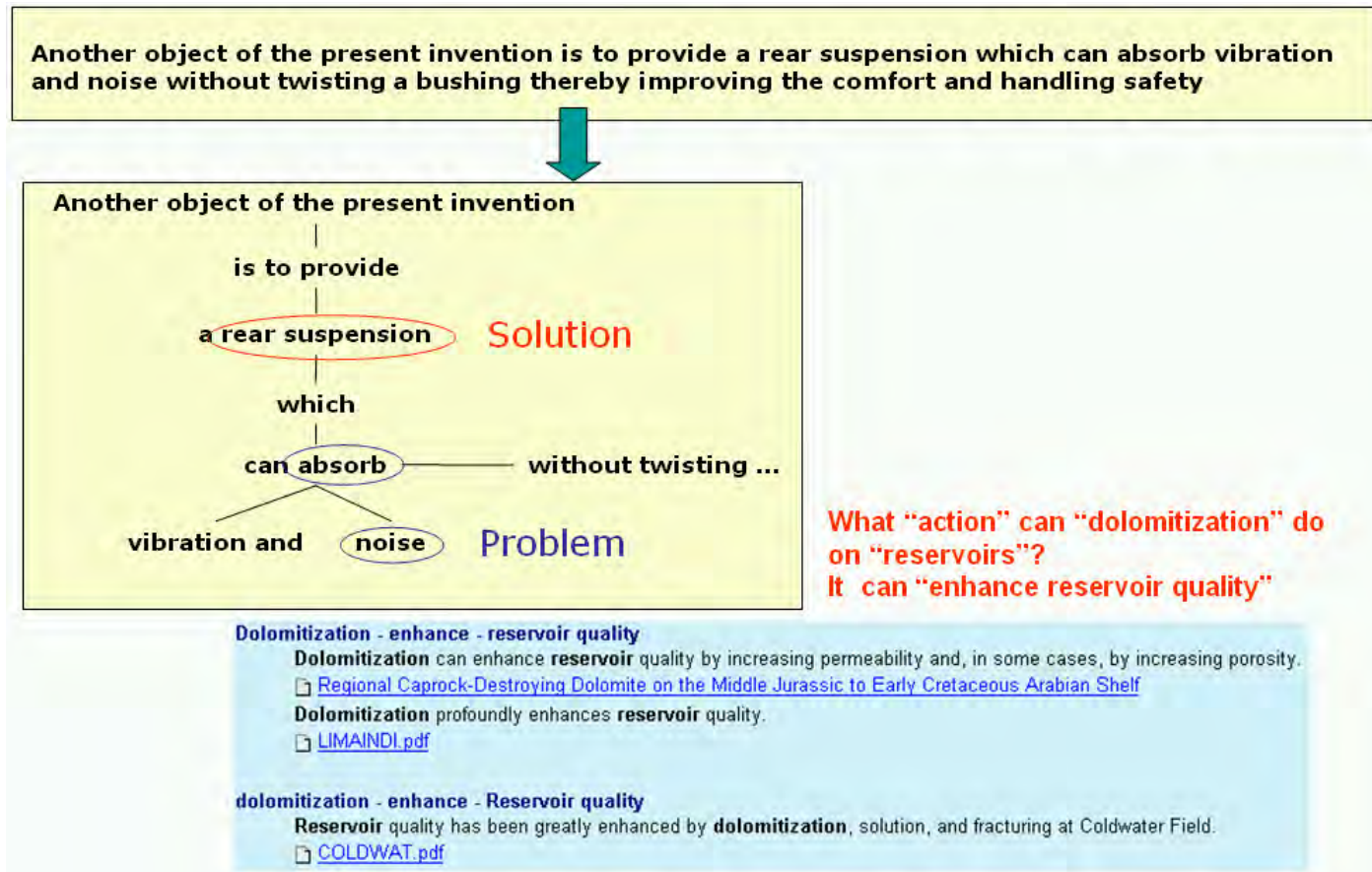
Acknowledgements

Fig. 8

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