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The Harmonization of Geological Information Through Standards
The Case of Kelaat M'Gouna and Sidi Flah

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Abstract—Nowdays, the great explosion of the Geoscience data digitized, and diversity of independently developed information sources may be difficult to operated due to heterogeneous data sources (formats, structures) that exist in all of these systems, interoperability has become a pressing need to share geographic information and contribute to the harmonization of data. In fact, this study describes the mechanism of exchange of heterogeneous information through the mediation of geoscience information approach based on the international standards of Open Geospatial Consortium (OGC) such as Web Map Service (WMS), Web Feature Service (WFS) and Geoscience Markup Language (GeoSciML), that it would be usable by different customers.

Index Terms— Interoperability, OGC standards, Web Map Service, Web Feature Service, GeoSciML, Geology, Mediator.

1 Introduction

Spatial data has an important role in many social, environmental, economic and political decisions, and is increasingly acknowledged as a national resource essential for sustainable development [1-4]. In Morocco, public and private organizations that operate in the field of geosciences have a large number of spatial data that are generally autonomous and heterogeneous data sources. According to an operational point of view, data from multiple independently developed sources have different and incompatible types, formats and qualities [5, 6]. Moreover, most currently used standards have remained limited to one organization or one country [7], which makes interoperability between these data systems difficult, almost impossible. Furthermore, geospatial data are often acquired for special purposes which are often revealed in a different way from their future use [8].

The architecture in this article provides interoperability between different sources of data of geological information (geologic units) using OGC standards. The latest is an XML-based language for storing and transporting geospatial data[9], and the system of mediation to support the exchange of geoscience information.

2 State of of the art

Generally, the data come from heterogeneous sources e.g. public / private organizations, Institutes ... and each has its own platform, Database Management System (DBMS), spatial data structure. Indeed, data sources are designed independently by different designers who have different application targets[10], this is what makes their operations very difficult to the users (researchers, engineers ...) who want to locate or exploit the information resources distributed due to low accessibility, incompatibility of different storage structures[11]. For example, two datasets can be organized in different ways in two databases of the same type or different type, i.e., names of tables or structures of the columns may be different even if they describe the same information (Figure 1). Therefore, access to information must be carried out according to internal standards of the organization, and not according to international standards.

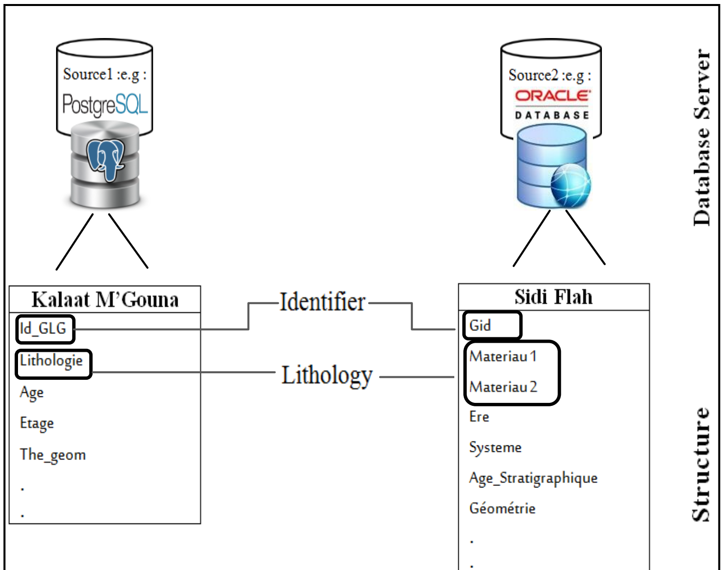

Fig.1.The heterogeneity of structures and sources

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3 Case Study

Databases that are the subject of the test represent a sample of two geological maps 1/50 000 that are juxtaposed, Kelaat M'Gouna [12] and Sidi Flah [13] that are part of a batch of 6 geological maps produced in collaboration with the USGS in the context of the National Plan of the geological mapping (Figure 2). In fact, these data have been selected for use in the study of case for the following reasons:

1. The data perfectly reflect the heterogeneity problem, namely, the difference of the DBMS used as well as the inconsistency in terms of patterns of data structures.
2. The prioritisation of geological data was carried out according to standards [14].

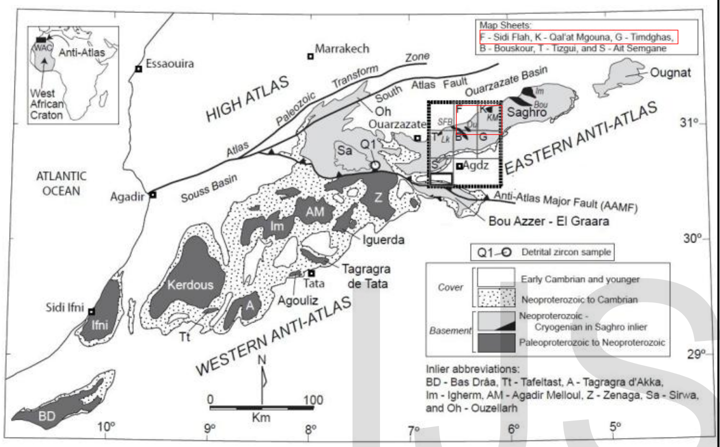

Fig.2. Geological map of Western Anti-Atlas [15]

4 Methodology

In this part we are going to initiate various possible approaches and their feasibility in order to solve the problem of heterogeneity. Two approaches have been identified to make geospatial data interoperable.

4.1 The centralization approch

It means to develop a "data warehouse" well standardized which encompasses all the information (Structures, Database, etc...) (Figure 3) and existing geological data in a common plan or a common database scheme, using a set of standards and ontologies[16] .Consequently, this approach is very difficult to implement, due to the volume of information that is stored in various distributed databases. Moreover, no organization wants to share its own information in public without any commitment [17]. In this case, a centralized control is not an option.

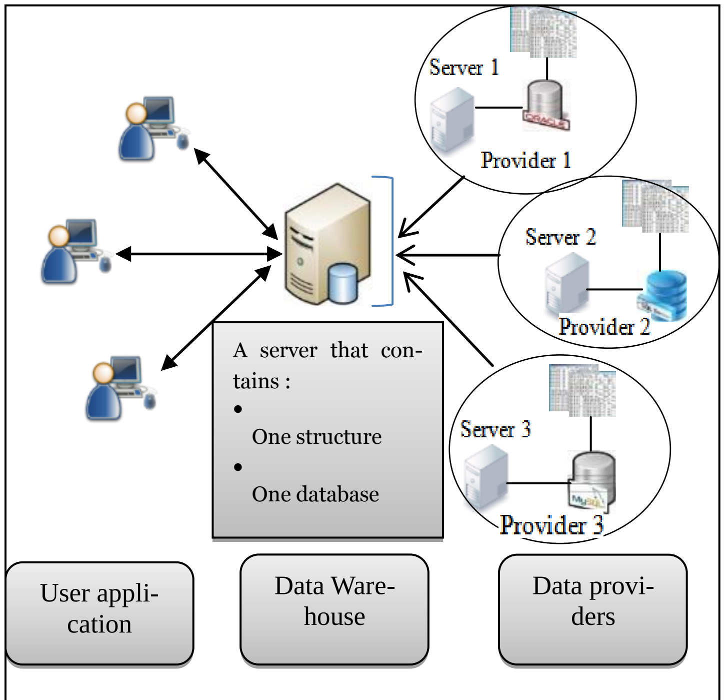

Fig.3.The centralization approach of geological information

4.2 The mediation approach

The mediation approach (figure 4) which was originally described by Wiederhold [18] consists of the establishment of a mediator between the data sources and the user application [18], which solves the problem of the distribution of the data sources, using the transformer "wrapper" that logically converts the objects of each source of data into a common information model [17] based on the web services of OGC and the standard of GeoSciML.

The strong point of the mediation approach is to facilitate the access to geographic information maintained by a wide range of stakeholders, by opting for the use of OGC standards [19]. Thus, this approach promotes the reuse of the already existing data inventories for future uses that are not yet identified [8].

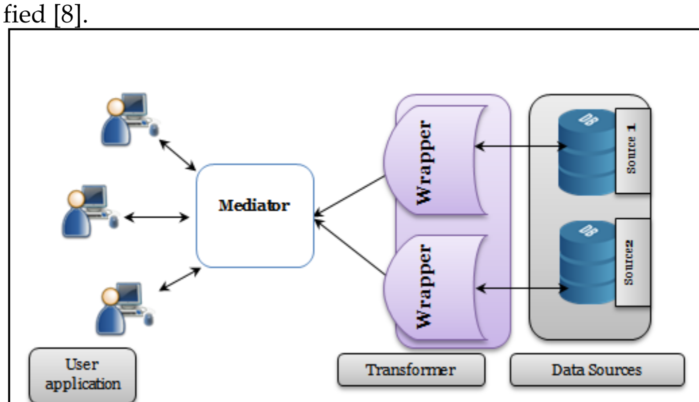

Fig.4.The mediation approach

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In order to unify the data structures of the two sources, in our case Kelaat M'gouna and Sidi-flah (Postgresql and Oracle), so that it would enable the interoperability and merging of geospatial information, we opted for the mediation approach, which does not require no changes in the used DBMS nor at the structure of the entities for its implementation. In order to access the geological data stored in different sources, we have used international standards of OGC which are used by most of the organizations that work in the Geoscience field [20] so that it allows the visualization and the provision of these data regardless of the systems used, and the application of data model GeoSciML (Figure 5) governed by the Commission for the Management and Application of Geoscience Information (CGI) [21] to support interoperability of geological and other information data custodians [21], based on international standards such as Geography Markup Language (GML) [22] and the World Wide Web Consortium (W3C), so as to provide a framework for applications that arise on geological criteria (geological units, geological structures, fossil) [23] or research artefacts related to maps and geological observations to support the exchange of geoscience information [24]. Indeed, web services (WMS and WFS) and the GeoSciML are the keys to the interoperability and exchange in our system.

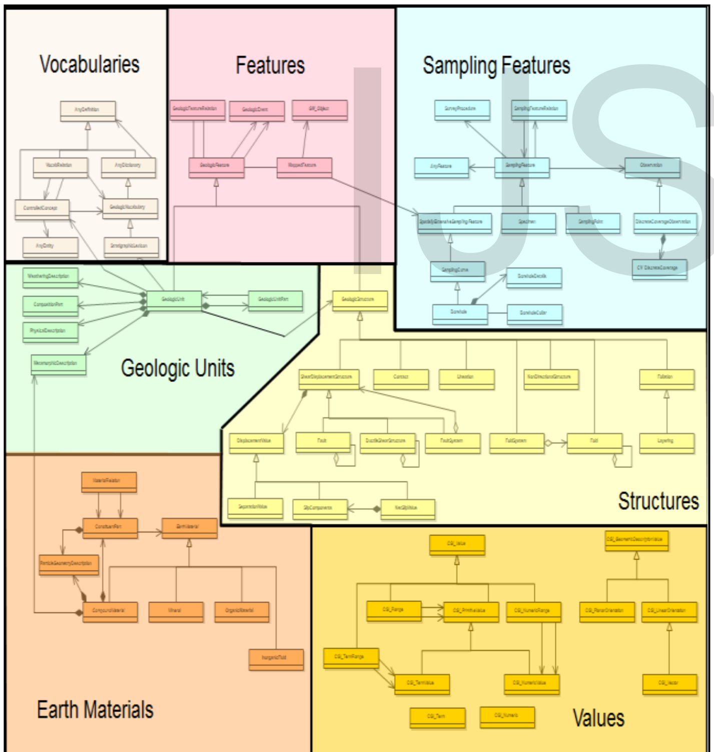

Fig.5. Overview of the GeoSciML model [25]

The Geospatial data coming from the two data sources in our case study were mapped from the native pattern to the standard scheme of the GeoSciML. This allowed us to provide a standardized interface, which aggregates geospatial information of both databases (PostgreSQL, Oracle). Indeed, the GeoSciML describes the basic elements of a geological map, in order to facilitate communication between geological databases from multiple sources, without changing their original format and structure [26]. Therefore, we have reconciled between our databases elements (fields from tables in databases) and the properties defined with GeoSciML. At this point, the web services (WMS, WFS) striving to create independent interfaces (Figure 6) systems and thereby increase overall availability of data based on existing standards of the computer world.

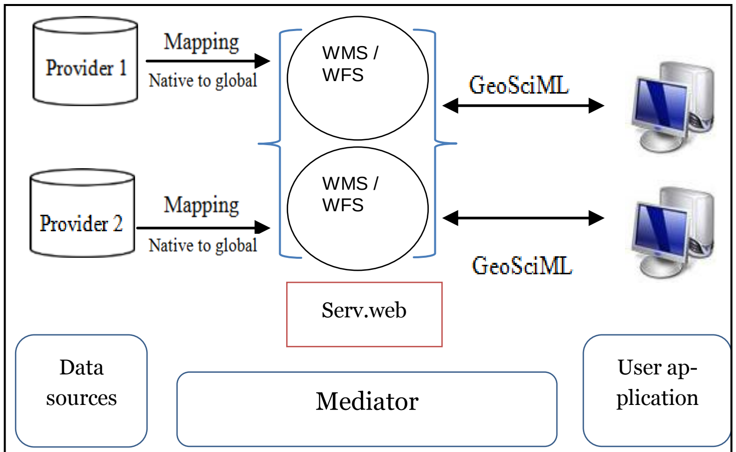

Fig.6. Communication among user application and providers using GeoSciML and WMS/WFS

5 Results

The use of the mediation system and the implementation of web services have given to present system wide flexibility to exploit the geological data stored in our database, with a standardized structure (Figure 7). Indeed, the access to the information becomes open to the user application (QGIS, ArcGis, Deegree...) that support OGC specifications (Figure 8).

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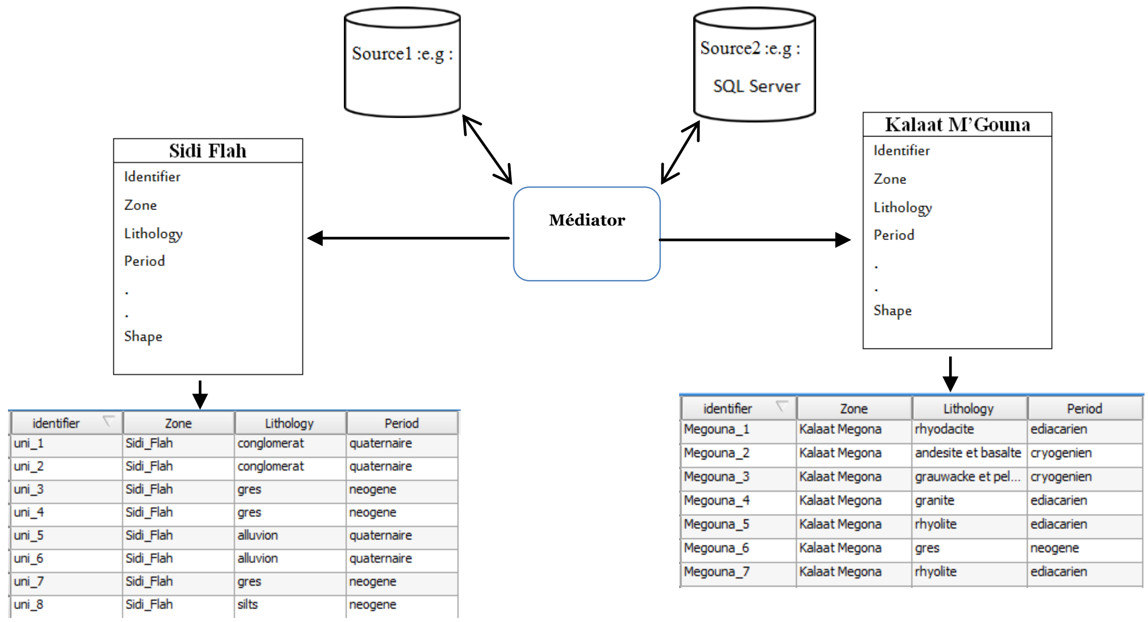

identifier	Zone	Lithology	Period
uni_1	Sidi_Flah	conglomerat	quaternaire
uni_2	Sidi_Flah	conglomerat	quaternaire
uni_3	Sidi_Flah	gres	neogene
uni_4	Sidi_Flah	gres	neogene
uni_5	Sidi_Flah	alluvion	quaternaire
uni_6	Sidi_Flah	alluvion	quaternaire
uni_7	Sidi_Flah	gres	neogene
uni_8	Sidi_Flah	silts	neogene

identifier	Zone	Lithology	Period
Megouna_1	Kalaat Megona	rhyodacite	ediacarien
Megouna_2	Kalaat Megona	andesite et basalte	cryogenien
Megouna_3	Kalaat Megona	grauwacke et pel...	cryogenien
Megouna_4	Kalaat Megona	granite	ediacarien
Megouna_5	Kalaat Megona	rhyolite	ediacarien
Megouna_6	Kalaat Megona	gres	neogene
Megouna_7	Kalaat Megona	rhyolite	ediacarien

Fig.7.The structures of two data sources

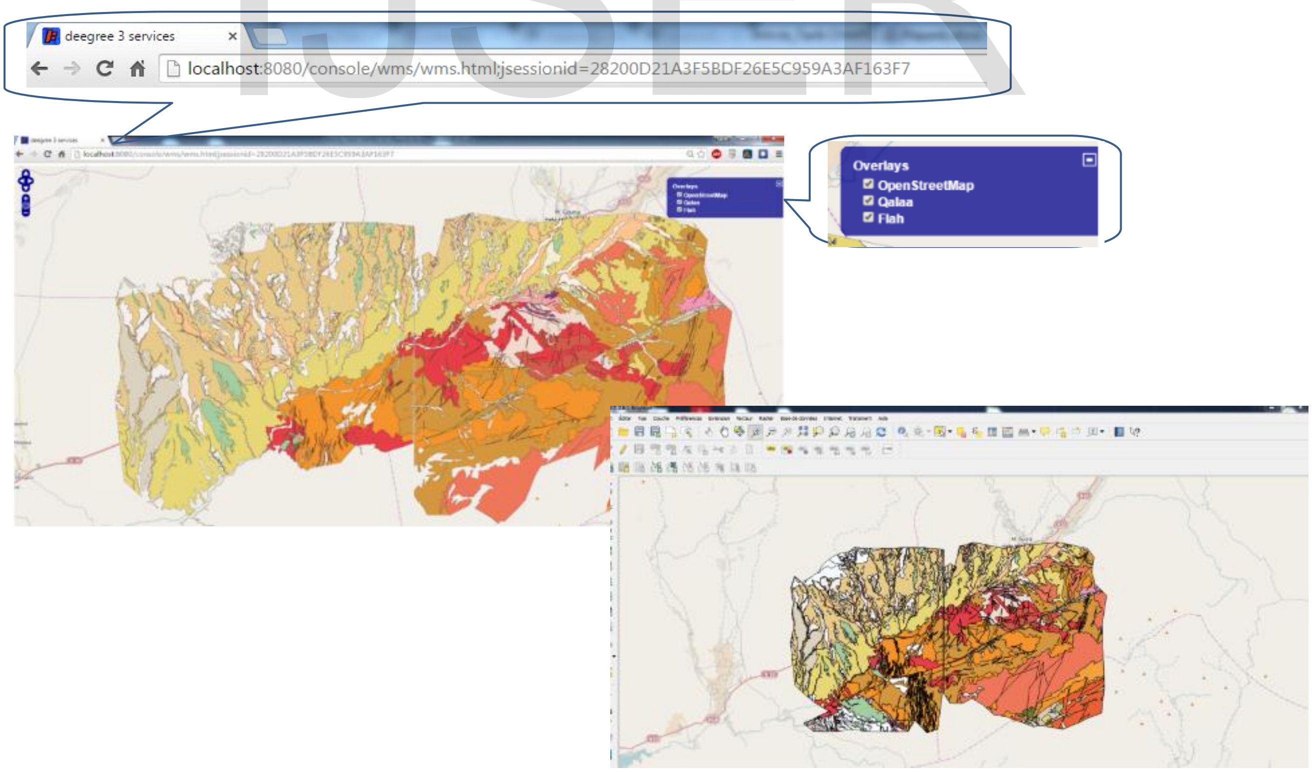

Fig.8. Access to information via the various customers
(Deegree, QGIS…)

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6 Conclusion and perspective

The geoscience information is generally present as maps (paper), since the digital format is almost limited at our disposal to discover a large area that is a city or a whole country, which complicates more the aims of the stakeholders for the exploitation and exploration of the geoscience information.

As a perspective, we intend to work on a mechanism based on the ontological approach which belongs to the standards of W3C dedicated to the Semantic Web [16] in order to specify standardized vocabularies between the various sources of geology to identify structural and semantic interoperability in system.

References

[1]. Paudyal, D.R., K. McDougall, and A. Apan, Building SDI Bridges for Catchment Management in SDI Convergence Research, Emerging Trends, and Critical Assessment, J.W.J.B. B. van Loenen, J.A. Zevenbergen, Editor. 2009, Netherlands Geodetic Commission: Netherlands.

[2]. Rajabifard, A. and I.P. Williamson. Spatial Data Infrastructure (SDI), SDI Hierarchy, Partnerships, Culture for sharing. in GEOMATICS'80 Conference. 2001. Tehran, Iran: Engineering: Department of Geomatics.

[3. Rajabifard, A., SDI Design to Facilitate Spatially Enabled Society in Towards a Spatially Enabled Society, Melbourne, T.U.o. Melbourne, Editor. 2007. p. 219-232.

[4]. Kevin, M., R. Abbas, and W. Ian, A Mixed-Method Approach for Evaluating Spatial Data Sharing Partnerships for Spatial Data Infrastructure Development, in Research and theory in advancing spatial data infrastructure concepts, ESRI, Editor. 2007, ESRI: USA. p. 55-73.

[5]. Zhao, P., T. Foerster, and P. Yue, The Geoprocessing Web. 2012 Elsevier Ltd. All rights reserved., 2012.

[6]. Giuliani, G., et al., WPS mediation: An approach to process geospatial data on different computing backends. Computers & Geosciences, 2012. 47(0): p. 20-33.

[7]. Laxton, J.L. and T.R. Duffy, Developing and implementing international geoscience standards: a domestic perspective. 2011.

[8]. KIEHLE, C., R. AZZAM, and T. M. FERNANDEZ-STEEGER, Revealing distributed geoinformation for engineering geological applications. The Geological Society of London, 2006.

[9]. Pazoky, S.H. and F. Hakimpour, Transforming GML to Presentation Languages by Extending XSLT. Journal of Geographic Information System, 2014. 6: p. 59.

[10].Nguyen, D.X., Intégration de bases de données hétérogènes par articulation à priori d'ontologies: application aux catalogues de composants industriels. 2006, Université de Poitiers.

[11].Kumar, C., C. Rao, and A. Govardhan, A Framework for Integration and Standardization of Data from Heterogeneous Sources. American Journal of Database Theory and Application, 2012. 1(1): p. 1-7.

[12].Stone, B., et al., Carte géologique au 1/50 000, Feuille Kelâat M'gouna. Notes et Mémoires du Service Géologique du Maroc, 2008. 468.

[13].Stone, B., et al., Carte géologique au 1/50 000, Feuille Sidi Flah. Notes et Mémoires du Service Géologique du Maroc, 2008. 467: p. 114.

[14].Cohen, K., S. Finney, and P. Gibbard, ICS International Chronostratigraphic Chart 2015/01. 2015.

[15].Choubert, G., Histoire géologique du Précambrien de l'Anti-Atlas. 1964: Éditions du Service géologique du Maroc.

[16].L.Liu and Özsu, M.T., Ontology. Springer-Verlag, 2008.

[17].Stoimenov, L. and S. Đorđević-Kajan, Framework for semantic GIS interoperability. FACTA Universitatis, Series Mathematics and Informatics, 2002. 17(2002): p. 107-125.

[18].Wiederhold, G., Mediators in the architecture of future information systems. Computer, 1992. 25(3): p. 38-49.

[19].Hamylton, S.M. and J. Prosper, Development of a spatial data infrastructure for coastal management in the Amirante Islands, Seychelles. International Journal of Applied Earth Observation and Geoinformation, 2012. 19(0): p. 24-30.

[20].Klopfer, M., Interoperability & Open Architectures:An Analysis of Existing Standardisation Processes & Procedures 2005.

[21].Smyth, C., Leveraging International Earth Science Standards to EnhanceMineral Exploration Success in British Columbia. 2012: Earth Science Standards forMinerals Exploration in British Columbia. p. 59.

[22].ISO/TC (International Organization for Standardization/Technical Committee) 211, Geographic Information-Geography Markup Language (GML): ISO 19136. 2007: p. 421.

[23].M. Richard, S., GeoSciML – A GML Application for Geoscience Information Interchange. 2006: p. 47 - 59.

[24].Cox, S., Ardlie. Nicholas GEOSCIENCE AUSTRALIA AND CSIRO developing the GeoSciML interoperability standard with Enterprise Architect. 2009.

[25].Raymond, O., GeoSciML, in the GeoSciML Workshop at the 33rd IGC in Oslo,. 2008: Norway.

[26].Laxton, J., J.-J. Serrano, and A. Tellez-Arenas, Geological applications using geospatial standards–an example from OneGeology-Europe and GeoSciML. International Journal of Digital Earth, 2010. 3(S1): p. 31-49.