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"Geological Setting/Cadre Géologique" in English and French Petrology Articles: Muted Indications of Explored Places

Dacia F. Dressen and John M. Swales

Summary

There has been considerable interest over the past 15 years in the scientific research article, its schematic structure and how it responds to discourse community expectations. While these features have been widely investigated in numerous disciplines, relatively scant attention has been paid to the important discipline of geology. Moreover, within the sub-discipline of petrology, we find a sub-section as yet unrecognized in the extensive literature on the research article. The 'Geological Setting' (GS), an introductory part-genre occurring before the onset of petrological analysis, is a multi-functional description which frames researchers' results within their geological context. Based on a corpus of 20 articles (10 in French and 10 in English), it is argued that this part-genre is not only a complex of the topography, geological history and characteristics of the research site, but also serves to establish the authors' credentials and authority as experts. This is accomplished not through agentive narratives marking the authors' presence on the site, but through more muted and indirect means. Similarities at the macro-level and general discourse structure are found in both the French and English texts, with important stylistic differences on a local level.

Introduction

There is an established trans-disciplinary tradition of associating genre knowledge with power and authority that at least goes back to Foucault (1972). However, in applied genre analysis the concept of expert manipulation of genres for tactical advantage has only come into prominence since the publication of Bhatia's *Analyzing Genre* in 1993. In very recent years, we are thus encouraged to recognize the authoritative, institutional voice which has the "power to use, interpret, exploit and innovate novel generic forms" (Bhatia 1997a: 362). Within this conceptualization, which has many points of contact with Critical Discourse Analysis, this power to innovate is largely seen as being realized through the deliberative mixing or embedding of genres, such as the "commodification" of British university prospectuses (Fairclough 1982), or the increasing uses of promotional strategies in introductions to academic books and similar texts (Bhatia 1995).

While we do not doubt that such hybridizing and commodifying processes can be shown to be at work in contemporary academic and professional genres, we are less sure

about the extent of these developments, especially in academic universes of discourse. We suggest that it is just as likely that what we are seeing in contemporary genre studies is a growing realization that genre exemplars are complexly multi-functional; in effect, we are looking as much at new *insights* into discourses as at new textual developments per se. Consider, for example, the case of authors' prefaces to their books since these are discussed as instances of the "new promotionalism" in Bhatia (1997b). In this context we could do well to look once again at the justly famous preface by naturalist John Ray to his *The Wisdom of God manifested in the Works of Creation*, published in 1691:

In all ages wherein Learning hath Flourished, complaint have been made of the Itch of Writing, and the multitude of worthless Books, wherein importunate Scriblers have pestered the World... I am sensible that this Tractate may likely incur the Censure of a superfluous Piece... *First*, therefore, in excuse of it I plead, That there are in it some Considerations new and untoucht by others; wherein if I be mistaken, I alledge *Secondly* that manner of Delivery and Expression may be more suitable to some Mens Apprehension, and facile to their understandings. If that will not hold, I pretend *Thirdly*, That all the Particulars contained in this Book, cannot be found in any one Piece known to me, but ly scattered and dispersed in many, so this may serve to relieve those Fastidious Readers, that are not willing to take the Pains to search them out; and possibly, there maybe some whose Ability... will not serve them to purchase... those Books, who may yet spare Money enough to buy so inconsiderable a Trifle.

This marvelously stepped argument indeed makes its four promotional points, but does so with self-conscious irony, with self-deprecatory with and with highly artful modesty. And, of course, this "so inconsiderable a trifle" is over 300 years old.

While such 'puffs' (and their associated demurrals) have probably been around as long as there have been creative written works, there also remain established alternative traditions of diffidence, indirectness and deflection wherein authors tend to decline opportunities for valorizing their own scholarly achievements. There can be patterns of Becker's (1995) "silential relations" here, and these can be shown to be further prone to different levels of modesty in different academic cultures (e.g., Mauranen (1993) for Finnish and Block & Chi (1995) for Chinese). Indeed, matters can be variable within a particular field in a particular culture. In Biology, for instance, the science investigated by discourse analysts *par*

excellence, there are worlds of difference in "how much is made of" the discovery of a new mammal, bird, or plant. The first makes the newspaper headlines, the second may warrant the publication of a ten-page article in a leading journal accompanied by color plates (Gross 1990), while the third is only indicated by a short diagnostic paragraph in Botanical Latin and the tiny, unobtrusive abbreviated notation in the front matter -- *sp. nov.* (Swales 1998). When a professor of Botany was asked at our institution how many plant species "new to science" were described each year, he replied "I don't know, nor do I suspect does anybody else, but it must be thousands" (W. Anderson, p.c.). In consequence, here we find muted accounts of discoveries, neither trumpeted in press releases, nor commodified in any other way.

While Biology articles have commanded a great deal of attention (e.g., Myers 1990; Dubois 1987; Selzer 1993), our knowledge of other disciplines, such as Geology, remains scanty. Although Love (1991, 1993) has provided useful analyses of geology textbooks, studies of the Geology RA are currently confined to small-scale investigations into Geotechnical papers (Een 1982; Cox 1995), to Jolivet's (1998) ongoing contrastive work in geology, economics and medicine, and to the general and historical review of the stylistics of geological writing found in Montgomery (1996). Another noticeable gap in the applied linguistics literature is the paucity of studies that contrast French and English scientific writing; for example, French is little mentioned in either Connor (1996) or in the 1997 collection edited by Duszak. Important but rare exceptions are Régent (1985) who argues that differences in visual aspects of the printed page, and in sequences of discursive and communicative acts, are caused by slightly different philosophies of science in the two cultures, and again, Montgomery (1996) who discusses the more "literary" and "writerly" qualities still to be found in Francophone geological papers, but now largely absent from their Anglophone counterparts.

In this chapter, we attempt to respond to these lacunae by investigating a corpus of 20 texts in the important geological sub-discipline of petrology. As its name implies, petrology is

concerned with the description, classification, and analysis of rocks. We have noted that a certain number of petrology articles contain a subsection intervening between the introduction and the methodology/results sections. This subsection, most typically called "Geological Setting" (GS) in English and "Cadre Géologique" in French, has not to date been reported on in the now-extensive literature on the schematic structuring of subsections in the scientific research article. We argue that this addition reflects an alternate framing for geological research (i.e., one that originates in phenomena observable on the terrain rather than around laboratory analyses). As such, it is primarily characterized by a series of general-to-specific descriptive statements which describe the topographical, historical, and physical features of the terrain from which the rock samples have been taken. The depiction of this type of background information has, over the years and decades, become largely conventionalized in the form of a part-genre (Ayers 1994).

On one plane, then, these GS elements provide a historical and topographical contextualization for the analytic work to be discussed in the body of the paper. However, on another plane these elements also serve to establish the authors' credentials as experts in their chosen and often remote locales, although today this credentialization is only rarely achieved by 'self-promotional' human agency, but via muted and indirect means. We also show in the chapter that the French and English texts in the corpus show surprising similarities at (macro) discursal strategies, but diverge consistently in grammatical tactics.

Background

Our first look at petrology articles showed that in the first 20 articles, 12 (60%) contained a sub-section that we eventually decided to be the GS part-genre. We then scanned further petrology periodicals to arrive at a working corpus of 10 articles in English and 10 in French. We estimate that these sections are likely to occur about 50% of the time in petrology. Details of the corpus are given at the end of this chapter¹. The actual articles are

listed in the Appendix and are referred to by letter (A-T) throughout the remainder of this chapter.

The average length of the GS section was 619 words for English and 659 words for French, with outliers at 298/237 and 1453/1130 for English and French, respectively. In 19 cases, the GS section was initially marked by a named subheading. The nomenclature here is fairly, but not entirely, consistent. The use of 'geological/géologique' (in 15 of 20 titles), of a more general denomination than 'lithographical' or 'geochemical', combined with 'setting/cadre/contexte' (in 14 of 20 titles) effectively acts as a discursal indication that the GS contains general, background information. A few cases, however, do not adopt this seemingly more conventional naming practice; one is untitled, one uses 'field relations', and the remaining two indicate the precise subject of the GS (e.g., 'Granitoids in SW Japan' and 'Les granitoïdes des dolérites'). In those cases where a typographically marked onset was not clearly indicated, we looked for the "discursal patterning" to be discussed shortly, and in the rather more frequent occurrence of unmarked closure of the GS section, we set the ending of the section at the juncture where authors switched to geochemical analyses and quantified assays of the rocks. In addition, we have been assisted in this research by a number of Anglophone and Francophone geologists, who have generously offered their time and expertise as specialist informants. These individuals are named in the Acknowledgments.

Features of Geological Setting sections

Discursal patterns

If the GS is to be taken as a part-genre, we can assume that its exemplars would reflect disciplinary concerns specific to Geology. In both the French and English sub-corpora, elements reflective of these concerns were indeed found to occur with a high degree of frequency very early on in the GS, normally within the first paragraph. The sub-moves of these "GS openings" are noted as follows: Localization; Nomenclature; Visual support;

Formation composition; Age; Geological activity; Prior literature; Sublocalization; and Brief description of rocks.

Occurring in all twenty texts, 'Localization' may simply indicate the name of a geographical place (e.g., 'the Chilwa Island carbonatite'), or may be determined in terms of the geological terrain (e.g., The Karakoram batholith runs the length of the High Karakoram range in northern Pakistan, Ladakh, and westernmost Tibet). In the next most frequent type of sub-move (i.e., 'Nomenclature', in 19 out of 20 texts), the rock- or formation-type is identified, as in 'The Laramie anorthosite complex' or 'les dolérites'; it often occurs in close conjuncture with the given location. We have also noticed in 17 of the 20 texts that authors provide some map or figure to help the reader visually determine the exact geographical location of the formation, as well as how it appears on the terrain in relation to surrounding geological features. Equally frequent is the sub-move which identifies the formation's composition, in terms of its rocks and/or minerals. Very often, this sub-move directly proceeds a detailed petrological description of the minerals and their composition. A majority of texts in our corpus (12 of 20) also indicate both the geological age of the formation, as well as what type of geological activity has taken place (e.g., the chemical or compositional alterations of surrounding elements). These patterns can be seen in the following three examples:

- | | | |
|-----|------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| (1) | Localization
Visual support
Nomenclature
Age
Geological activity

Sublocalization
Formation composition | In the Oatlands district,
(fig.1)
basalts of the
Oligocene and Early Miocene age
occur as isolated flow remnants and plugs.
They form part of a much larger Cainozoic basalt
province
that extends along the length of eastern Australia.
Upper crustal rocks include carbonaceous shales and
quartz sandstones... [A] |
| (2) | Nomenclature
Localization
Visual support | The Laramie anorthosite complex (LAC)
is exposed over 800 km ² in southwestern Wyoming
(fig. 1) |

Age	and represents the northernmost component of wide-spread 1.4 Ga magnetism in the western USA.
Geological activity Sublocalization	The LAC is inferred to have intruded the Cheyenne belt, a major terrane boundary that separates Archean rocks of the Wyoming province to the north from accreted 1.7-1.8 Ga rocks of the Colorado province to the south. [E]
(3) Nomenclature Localization	<i>Le massif volcanique du Mbam occupe une superficie de 450 km² sur la bordure NW du plateau Bamoun, unité médiane des Hauts Plateaux de l'Ouest-Cameroun.</i>
Formation com- position	<i>Sur un substratum constitué de granitoïdes</i>
Age	<i>d'âge probablement panafricain,</i>
Geological Activity	<i>il est constitué de deux épisodes volcaniques distincts</i>
Visual support	<i>(fig. 1).</i> [T]

'The Mbam volcanic massif crops an area of 450 km² on the NW range of the Bamoun Plateau, the central zone of the Hauts Plateaux of western Cameroon. Its basement consists of granitoids, probably of Panafrican age, and the massif consists of two distinct volcanic episodes.'

An immediately obvious feature of these GS openings (and of others in the corpus) is the amount of territory covered in only 2-3 sentences. They are further marked by a movement from general to specific, and by their handling of the Setting in a tight, highly conventionalized, and largely uniform way.

Lexical verb choice

In order to capture another aspect of these texts, all lexical verb choices (both finite and non-finite) in the twenty English and French GS sections were counted. Around 440 verbs were found for each sub-corpus, and were situated in four types of rhetorical context: (1) the description of the geological setting itself; (2) accounts of previous studies of the area; (3) accounts of what the authors have done themselves (i.e., reporting verbs as in “We found...”); and (4) the authors' metadiscourse (e.g., “Details are *provided* in Appendix A”). The very clear predominance of the descriptive task in both English and French (around 88% and 95% of all verbs, respectively) reinforces the textual impression that the authors here are dedicated to providing the broader geological context for their study. References to previous

studies (category 2) account for fewer than 10% of the verbs, while categories 3 and 4 have very few tokens. Table 1 reflects the kinds of lexical verbs which occur throughout the corpus.

<Table 1 about here>

As the most significant category, descriptive lexical choices have their own story to tell. First, the high frequencies of verbs such as *be*, *occur*, *have*, *contain*, *consist of*, *show* or *include* in English and *être*, *constituer*, *avoir*, *associer*, *contenir*, *correspondre* or *se présenter* in French underscore some preference for a stative synchronic account rather than an unfolding diachronic account of geological activity. This impression is corroborated by the fact that the majority of the verbs are stative (around 60% for both French and English) and intransitive (around 40%).

Another aspect emerging from the initial count of lexical verb choices is that few of the verbs in either language are explicitly geological. *Emplace* (3 occurrences) in English is certainly one, but most are instead “sub-technical” (cf. Birch 1996; Lowe 1995). There are, of course, some special geological uses -- and meanings -- of verbs of more general use. The most prominent of these in English are *intrude*, *cut*, *expose*, and *associate*, while in French they are *associer* and *recouper*. Finally, to round out the picture, we list those few instances in the corpus of lexical verb choices that are truly geological in nature: *cross-cut*, *accrete*, *grade*, *root*, and *transect*; or in French: *dater*, *effectuer*, *mettre en place*, *affleurer*, *alimenter*, and *étager*.

Through the choice of these verbs, petrologists, rather than describe their own interactions with their research objects, are seen to describe the actions and states of the rocks, minerals and formations which they have found either during their own terrain observations, or as described in the literature. Thus, whereas the tendency in some earlier

articles may have been to engage in ‘traveler’s tales’, relating the arduous nature of field work and of discovery in off-the-map kinds of places, by this decade the GS section is largely detached from human agency. The agentive narratives common in earlier petrology GS sections have disappeared except for relatively infrequent and mostly "weak-author-oriented" (Swales 1990) references to previous work on the research site.

Tense choices

The tense data shown in Table 2 further corroborate the unfolding story of the GS part-genre. As might now be expected, we find in both languages a strong predominance of present-tense description. Beyond that, there are some interesting variations between French and English.

<Table 2 about here>

The depiction of rock and formation emplacement in English, for example, shows the diachronic unfolding of geological time, using the past and perfect tenses.

4. Many of the sills have separated into layered granite-pegmatite couplets (Rockhold et al., 1987; Duke et al., 1988, 1992). [D].
5. These dykes were emplaced after the main period of penetrative deformation but still during granulite facies metamorphism [which] occurred in the time span between 2.53 and 2.48 b.y. and closely followed the formation of the igneous batholiths (Buhl, 1987; Vidal et al., 1988; Peucat et al., 1989). [B]

Here French differs markedly from English, in that around half of the ‘emplacement’ type verbs actually occur in the present tense, and that an extended account of geological activity is often 'tucked away' into non-primary grammatical elements, such as a noun phrase or the past participle.

6. *Les leucogranites peralumineux carbonifères se mettent en place le long de la zone de collision et forment des alignements très caractéristiques suivant de grandes failles...* [L]

'The carboniferous peraluminous leucogranites are emplaced along a collision and form characteristic alignments along major faults...'

7. *Les leucogranites de la Brême seraient synchrones de la fin des événements tectono-métamorphiques acadiens développés entre 400 et 360 Ma dans le nord-ouest du Massif central.* [K]

'It would appear that the Brême leucogranite is synchronous with the end of the tectono-metamorphic Acadian phase which occurred between 400 and 360 Ma in the northwest Massif Central.'

As we can see in example 7, the present conditional (*seraient*) anchors the emplacement process, seen here as a carefully constructed unit consisting of a temporal marker (adjective 'synchrones'), combined with a temporally-bounded noun phrase ('la fin des événements tectono-métamorphiques acadiens') with a corresponding past participle ('développées'), and an indication of the time period ('entre 400 et 360 Ma'). The above example is by no means a solitary case; in fact, this type of multi-faceted strategy for indicating the emplacement process occurs throughout the French GS sections in our corpus, an observation confirmed by our French native-speaker geology informant.

As can also be seen in Table 2, authorial comment occurs overwhelmingly in the present tense in both languages, and is accompanied by linguistic markers of hedging, such as modals and epistemic verbs, as well as by references to past work. Most occurrences in this category are for the purpose of evaluation, as seen in the following examples.

1. *Si l'on peut exclure leur origine par démantèlement de niveaux sédimentaires indurés, on ne peut pas exclure un bref transport en milieux aqueux, les centres émissifs situés probablement en mer à l'ESE de l'île de Kasserine (Sassi, 1974).* [O]

'Although it is possible to rule out an origin from the breakdown of hardened sedimentary strata, one cannot rule out a short-time transport in an aqueous medium, the vents being probably located under the sea to the ESE of Kasserine Island (Sassi, 1974).'

2. *Un seul processus, continue, de genèse et de mise en place fondé sur la continuité structurale et géochimique entre le complexe de la Brême et le massif de Saint-Sylvestre est envisagé par de nombreux auteurs (...). D'autres se sont appuyés sur des données radiométriques (...) et sur une étude de pétrologie structurale (...) pour proposer une formation en plusieurs étapes.* [K]

'A single and steady process for the genesis and emplacement based on the structural and geochemical continuity between the Brême complex and the Saint-Sylvestre massif is

envisioned by numerous authors (...). On the basis of radiometric data (...) and a structural petrology study (...), other authors have argued for a multi-stage formation.'

3. Such large rigid-body rotations could entirely invalidate the use of ductile movement directions, measured in a present-day coordinate frame, for the reconstruction of palaeotectonic environments (e.g., Vauchez & Nicholas, 1991). [F]

One final note about the tense data concerns the authors' accounts of previous studies.

In general, the GS in the present corpus gives the appearance of being a neutral terrain, where the authors are especially concerned with establishing what is known about the formation.

This observation is corroborated by a number of features. First, we can note the overwhelmingly "weak-author-orientation" (e.g., Swales 1990) of the citations present in the corpus. Furthermore, the great majority of references to past work adopt a parenthetical strategy, which in part explains the small percentage of verbs dedicated to this end. Moreover, authors cite themselves infrequently; only three of an average of twenty citations per article refer to their own previous work. In this sense, then, the GS does not seem to be considered the right place to stake out territory nor to establish the researchers' credibility and authority by reporting on the extensiveness of their previous work on the site.

Noun phrases as markers of professional expertise

As we have already noted, a demonstration of extensive fieldwork in GS sections is hardly typical. Nonetheless, the authors must still signal, however mutedly, that they have indeed been on the terrain. Expertise in the locale and the authoritative voice of the expert are thus to be demonstrated by the description of the data. It is here that the linguistic and discursal markers which proclaim to the reader "We were there" are to be found, rather than in the type of agentive narrative common in earlier petrology texts.

As seen previously, verbs in GS sections tend to avoid the technicalities of geological descriptions, which in both English and French are shunted into instrumental noun phrases. They both may also further rely on non-finite verbal (participial) phrases or verbal modifiers to carry the technical aspects of the account.

(1) The intrusions have domal structures which grew laterally by continual emplacement of numerous sills and dikes, indicating extraction on small batches of melts from the sources. [D]

In English, the extensive use of extended (and essentially processual) noun phrases and non-finite verbal, adverbial and adjectival modifiers as “product-markers”, are densely interspersed throughout the GS section, and describe the physical development of the terrain (i.e., the “process”). This is clearly demonstrated in the following example:

(2) The peridotite overlies high-grade gneisses and marbles...along an essentially low-angle brittle thrust marked by extensive brecciation discernible over a distance of up to 100 m away from the context. [F]

We might note that the two preceding passages are marked especially by process nouns used to describe some physical feature of the rock or formation (e.g., emplacement, extraction, thrust, brecciation), as well as by adverbial movement (e.g., along a thrust, over a distance, up to 100 m away from), resulting in a complex and skillful description made by the geologist on the terrain. Because convention apparently no longer allows geologists to come out and say “We went to the site, we picked up some rocks, and we saw that they were situated in a certain manner, which suggests to us that...”, this type of construction serves as a notice to the readers that there has been an actual ‘taking in’ of the terrain with a specialist’s eye, rather than an account which has merely been gleaned from the literature.

Such extended phrasal description is extremely common throughout the English sub-corpus, where nearly every sentence uses this compact strategy for relaying the technicalities of geological description. In this sense, then, we can see that the directness of the English texts is best characterized by a reduction to bare verbal movement, where one can see a ‘skeletal’ descriptive subject-verb embedded in the technicalities of geological description.

The placement of technical jargon into noun phrases is also seen to occur in French, although with some slight differences.

(3) *Ils contiennent deux types d'enclaves, (i) des enclaves microgrenues sombres suggérant l'intervention précoce de magmas basiques avec possibilité d'hybridation par des processus de type assimilation-cristallisation fractionnée et (ii) des enclaves crustales de*

socle métamorphique et de métasédiments, interprétées comme étant des restites d'une source essentiellement crustale. [L]

'[In these rocks], two types of enclaves are present, (i) microgranular dark enclaves suggesting an early intervention of basic magmas with possible hybridization through assimilation-fractional crystallization processes and (ii) crustal enclaves either of metamorphosed basement or of metasediments, interpreted as restitic material from an essentially crustal source.'

In particular, we can note that the NPs which contain the account's 'geological technicalities' remain more abstract than in English, where the more processual NP describes a physical state currently detectable on the terrain. While processual NPs are also present here (e.g., hybridation, assimilation-cristallisation fractionnée), they are in fact embedded within a larger, abstract noun phrase (e.g., possibilité, processus). As we will see shortly, French GS sections are marked by both more abstract and process NPs than is English.

Choice of voice and subject type: The agency of 'rocks'

As we have remarked earlier, GS sections are also marked by geologists' need to reserve agent-centrality for the rock itself. The central and even unusual role given to rocks and formations can be seen in the following passage:

“The Karakoram terrane, along the northwest frontiers of Pakistan and India, forms the southern continental margin of the Asian plate (Desio 1964). It lies immediately north of the Tethyan suture zones which mark the zone of collision between India and Asia (Fig. 1). The Shyok suture zone (SSZ) separates the Kohistan arc-microplate from the Karakoram terrane in the north and the Main Mantle Thrust (MMT) places the Kohistan arc-microplate southwards over upper and mid-crustal rocks of the Indian plate. Sedimentology along the Indus suture zone (ISZ) and north Indian plate margin in Ladakh and south Tibet suggests that closure of Tethys along the ISZ, and collision of India and Asia occurred between the early and mid-Eocene at ca. 50 Ma...” [H]

Immediately striking in this passage is the total absence of human researchers, where, as suggested by an abundance of inanimate subjects with active verbs, rocks and formations appear to act independently of the human hand, despite the obvious necessity of such human activities as geological mapping.

While it is widely believed that the passive is the key grammatical marker for attaining such humanless prose in English “scientific” styles, in contrast with French (Vinay & Darbelnet, 1996), analysts have in fact shown that the occurrence of the passive voice in English scientific prose is not as high as once thought. Indeed, several studies have shown the English language to have a wide range of strategies available to remove ‘the human agent’, rhetorically allowing for seeming greater objectivity (e.g., Tarone et al. 1981; Master 1991). Certainly it seems clear from the above passage that the passive is quite absent, and that the centrality of rocks and formations is indicated by other means.

Of 347 possible subject nouns in English and 389 in French, nouns referring to rocks and formations are by far the most frequent subject type found in both the French and English sub-corpora (77% and 86% of all subject NPs, respectively), clearly highlighting the essential role that they play in GS sections. Moreover, our analysis of the interplay of subject nouns and voice in these sections shows that rock and formation subject nouns in both the English and French sub-corpora are most likely to occur with the relational (26% and 27% respectively), as illustrated in the following examples.

(4) *Du quartz interstitiel ou des intercroissances quartz-feldspath sont souvent présents en faible quantité.* [P]

'Interstitial quartz or quartz-feldspath intergrowths are often present in small amounts.'

(5) The LAC represents the northernmost component of widespread 1.4 Ga magnetism in the western USA. [E]

Both French and English further demonstrate a preference for using the transitive with this type of noun rather than the passive (20% transitive vs. 16% passive in French, and 25% transitive vs. 19% passive in English).

(1) *Les granitoïdes calco-alcalins carbonifères recouvrent les champs de granite d'arc, des granites de collision, et des granites syn à post-collision.* [L]

'Calcalkaline carboniferous granites encompass the fields of arc granites, collisional granites and syn- to post-collisional granites.'

(2) *Le bassin de Maknassy-Mezzouna englobe une succession de petits bassins.* [O]

'The Maknassy-Mezzouna basin covers a series of smaller basins.'

(3) The massif is transected by sinistral strike-slip faults with estimated displacements of up to several hundred metres. [F]

As we have further noticed, the overall use of the passive voice in English GS sections is somewhat higher than in French (27% and 20% respectively), thereby lending credence to suggestions that Francophone writers need to pay attention to the English passive in scientific writing (e.g., Vinay & Darbelnet 1996; Villez 1996; Planes 1996). Although it uses a slightly higher number of passives than French, however, it is in fact in English that rock and formation NPs have the strongest tendency to occur with the transitive, and not in French, as we might have expected given that French uses more transitives overall (31% vs. 26% in English).

The trends of voice with abstract and process subject nouns, on the other hand, are quite different. First, abstract and process noun subjects occur nearly twice as frequently in French (20%) as they do in English (11%). Furthermore, when we focus on the correspondences between the choice of subject NP and voice, this preference in fact points to a significant contrast between French and English writing styles, as is indicated in Table 3.

<Table 3 about here>

As we can see, English GS sections show a very clear and significant preference for using the passive voice with this type of subject NP.

(6) Samples for study were collected from five localities. Descriptions of these and of the collected samples are given as follows. [A]

In contrast, while French authors do not show as clearly a marked preference for one particular voice as their Anglophone counterparts, they are nonetheless most likely to refer to abstract and process nouns in the transitive voice, and least likely to refer to them in the passive.

(7) *Les rapports isotopiques initiaux du strontium élevés indiquent une source magmatique crustale.* [L]

'High initial strontium isotopic ratios indicate a crustal magmatic source.'

(8) *Une coupe simplifiée (fig. 3) résume la série lithologique de l'Oued Abiod.* [O]

'A simplified cross-section summarizes the lithologic succession of Oued Abiod.'

The overall tendencies found in this analysis thus lead to the observation that the writing style of French authors in GS sections is more process-oriented, abstract and deterministic than that found in the English sub-corpus. Furthermore, while we most assuredly do not have the impression from these texts that passive use by Anglophone writers is an indication of their being less 'direct' in their description of the geological terrain, nor does the slightly higher use of passives in English in any way demonstrate that they have more difficulty in formulating firm judgments as some have suggested (e.g., Vinay & Darbelnet 1996), their texts are nonetheless clearly marked by a different descriptive strategy. In contrast, English GS sections appear more "boiled-down" and even at times clinical than those texts marked by the more "process-oriented" descriptive strategies of the French writer.

Discussion

Here, then, are texts which are rich complexes of description, geological process, the evaluation of prior claims, and the establishment of professional authority. As we have seen, they are linguistically quite similar on a macro-discoursal level, as seen in the manipulation of sub-moves in GS openings, the types of rhetorical categories governing verb usage, and the purposefully descriptive and objective distancing of the researcher which allows the rocks to 'tell their own story'. We have also seen important variations on a more local level. English GS sections, for example, while making the rock and formation the central active agents in its prose, minimizes the input of the author-researcher by overwhelmingly marking researcher and intellectual activity with the passive voice. Quite to the contrary of French, where it is more common to embed all activity, geological technicalities as well as researcher evaluation,

in active processual and abstract expression. These observed differences may provide us with one indication of why French geological texts may leave the impression of being more "writerly" and "literary" than the more "clinical" and "monotonic" English texts (e.g., Montgomery 1996).

These micro-level differences also confirm the results of other cross-linguistic genre studies (e.g., Melander et al. 1997), where reported differences at a local level are explained by the particularities of the local discourse communities in question. To our knowledge, only a handful of researchers have undertaken the task of exploring some of these differences in French and English (e.g., Régent 1985; Donahue 1998). To some extent, the characteristics particular to the Francophone and Anglophone discourse communities in Geology, although not highlighted in this chapter, have begun to emerge through our discussions with the geology informants consulted for this study.

Finally, we have been at great pains in this chapter to stress the petrology-intrinsic motivation for the existence of the additional GS part-genre and for its transitional placement between the "true" introduction and the petrological analyses. We have also hinted at its discursal evolution in recent decades from reports of geological *expeditions* to contemporary succinct and cumulative descriptions wherein the rocks and the geological processes that impinge upon them tell their own stories. It has, of course, not escaped our notice that petrology is not the only field-based discipline; others that easily come to mind include much of archeology, anthropology, ecology, fieldwork in biology, and even studies of endangered languages in linguistics or of isolated speech communities in sociolinguistics. While we might expect all researchers in field-based disciplines to establish their authority and credibility as experts in their chosen research-sites by various contextual and textual strategies, it remains, for now, an open question as to whether their tactics will be similar or different to the Anglophone and Francophone petrologists we have examined in this study.

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Notes

1. The corpus consists of twenty Geological Setting sections from four different French and British Petrology and Earth Science journals from the years 1990-1996. Six articles were taken from the *Journal of Petrology* and four from the *Transactions of the Royal Society of Edinburgh*. Five articles each were also taken from the *Bulletin de la Société Géologique de France* and from the *Comptes Rendus de l'Académie des Sciences: Sciences de la Terre et des Planètes*.

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Table 1. Lexical verbs occurring four times or more

ENGLISH	FRENCH
83 -- be	64 -- être
25 -- occur	15 -- constituer
14 -- form, intrude	12 -- avoir
13 -- have	11 -- associer, contenir
12 -- contain	10 -- correspondre
11 -- consist of, show	8 -- présenter (se)
10 -- cut, indicate	7 -- caractériser, recouper, situer (se)
7 -- separate, expose	6 -- affecter, s'agir de, limiter (se), montrer
6 -- include, represent	5 -- apparaître, appartenir, comporter, comprendre, représenter, varier
5 -- accompany, associate, range	4 -- apporter (se), conduire, développer (se), distinguer, exclure, expliquer (se), interpréter, observer, provenir, reposer, retenir, séparer, suggérer, suivre, supposer
4 -- appear, define, locate	

Table 2. Tense choice correspondences with rhetorical category

Rhetorical Categories	Description	Emplacement	Commentary	Previous studies	Present work	Metadiscourse
ENGLISH 347 total verbs	252 (73%)	30 (9%)	26 (7%)	26 (7%)	7 (2%)	6 (2%)
Present	97%	-	81%	12%	42%	83%
Past	1%	93%	4%	42%	29%	-
Perfect	2%	7%	5%	46%	29%	-
Future	-	-	-	-	-	17%
FRENCH 389 total verbs	275 (71%)	40 (10%)	44 (11%)	13 (3%)	10 (3%)	7 (2%)
Présent	98%	50%	100%	31%	-	67%
Passé Composé	2%	45%	-	69%	100%	-
Imparfait	-	5%	-	-	-	-
Futur	-	-	-	-	-	33 %

Table 3. Process and abstract nouns correlated with choice of voice

	Transitive	Stative/ Intransitive	Relationa l	Passive
English	10%	-	10%	80%
French	39%	24%	20%	17%