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# CANADIAN GEOSCIENCE MAP 101

GEOLOGY

## NORMAN WELLS (SOUTHWEST)

Northwest Territories



Map Information  
Document



Canadian  
Geoscience Maps

2013

Canada

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### **Cover Illustration**

View looking west at Franklin Mountain Formation dolostone in the hanging wall of the Norman Range Thrust. Mackenzie River and Mackenzie Plain can be seen beyond the Norman Range, with the Mackenzie Mountains in the left distance. Photograph by K. Fallas. 2012-139

## **ABSTRACT**

The southwest quadrant of Norman Wells map area (NTS 96-E) covers parts of the Franklin Mountains, Mackenzie Plain, and Mackenzie Mountains, Northwest Territories. The area varies from low-lying forested plain to alpine mountainous terrain, with bedrock exposures concentrated in the mountains on either side of the Mackenzie River. The geological interpretation in poorly exposed portions of the Mackenzie Plain has been enhanced by examination of public-domain seismic-reflection lines, archived with the National Energy Board. Cordilleran deformation from the southwest has uplifted Proterozoic and/or Paleozoic strata along reverse or thrust faults, and anticlinal folds in both the Mackenzie and Franklin mountains. The intervening Mackenzie Plain is dominated by folded and faulted Devonian and Cretaceous siliciclastic strata that have largely been planed off by glacial activity. The lack of surface exposure of Proterozoic strata in the Norman Range indicates this interval is not involved in Franklin Mountain structures, in contrast to the Mackenzie Mountains. An unconformity at the base of Upper Cretaceous strata cuts more deeply into underlying strata to the northeast, a

reflection of uplift along the Keele Arch before deposition of the Slater River Formation. Exploration by petroleum companies in the area has typically targeted potential reservoirs in buried Devonian strata.

## **RÉSUMÉ**

Le quadrant sud-ouest de la région cartographique de Norman Wells (SNRC 96-E) couvre des parties des monts Franklin, de la plaine du Mackenzie et des monts Mackenzie (Territoires du Nord-Ouest). La région passe d'une basse plaine boisée à des terrains montagneux alpins, où les affleurements du socle rocheux sont concentrés dans les montagnes, de part et d'autre du fleuve Mackenzie. Dans les parties moins bien exposées de la plaine du Mackenzie, l'interprétation géologique a été améliorée par l'examen de profils de sismique-réflexion du domaine public, archivés par l'Office national de l'énergie. La déformation cordillère en provenance du sud-ouest a soulevé les strates du Protérozoïque ou du Paléozoïque le long de failles inverses ou de failles de chevauchement, ainsi que par le jeu de plis anticlinaux dans les monts Mackenzie et les monts Franklin. Le sous-sol de la plaine du Mackenzie, en position intermédiaire, est formé en prédominance de strates silicoclastiques du Dévonien et du Crétacé, déformées par des plis et des failles, qui ont été en grande partie aplanies par l'activité glaciaire. L'absence d'affleurements de strates du Protérozoïque dans le chaînon Norman indique que cet intervalle n'a pas été repris dans les structures des monts Franklin contrairement à celles des monts Mackenzie. Une discordance à la base de la succession du Crétacé supérieur s'enfonce plus profondément dans les strates sous-jacentes, au nord-est, ce qui témoigne du soulèvement le long de l'arche de Keele avant le dépôt de la Formation de Slater River. L'exploration par les compagnies pétrolières dans la région a de manière caractéristique ciblé de possibles réservoirs dans la succession enfouie du Dévonien.

## **ABOUT THE MAP**

### **General Information**

Authors: K.M. Fallas, R.B. MacNaughton, B.C. MacLean, and T. Hadlari

Geological compilation by K.M. Fallas, R.B. MacNaughton, B.C. MacLean, and T. Hadlari, 2011–2012

Geological field observations by K.M. Fallas, R.B. MacNaughton, D. Midwinter, T. Hadlari, R. Lemiski (Northwest Territories Geoscience Office), J. Powell (University of Ottawa), 2009–2011, C.J. Yorath, M.E. Ayling, J.D. Aitken, D.G. Cook, and H. Balkwill, 1968–1969

Seismic data interpretation by B.C. MacLean, 2010–2012. Stratigraphic sections measured by T. Hadlari, R.B. MacNaughton, M. Sommers, B. Pratt (University of Saskatchewan), R. Acker, S. Hubbard (University of Calgary), 2009–2011, C.J. Yorath, W.S. Mackenzie, A.E.H. Pedder, and J.L. Usher, 1969

Geomatics by K.M. Fallas, P. Dhesi, S.D. Orzeck, and N. Raska

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Scientific editing by E. Inglis

Joint initiative of the Geological Survey of Canada and the Northwest Territories Geoscience Office, conducted under the auspices of the Mackenzie Delta and Corridor Project as part of Natural Resources Canada's Geo-mapping for Energy and Minerals (GEM) Program.

Logistical support provided by the Polar Continental Shelf Program as part of its mandate to promote scientific research in the Canadian North. PCSP 02509, 01310, and 00411.

Map projection Universal Transverse Mercator, zone 9.  
North America Datum 1983

Base map at the scale of 1:50 000 from Natural Resources Canada, with modifications.  
Elevation in feet above mean sea level

Mean magnetic declination 2013, 23°27'E, decreasing 31' annually.  
Readings vary from 23°36'E in the NW corner of the map to 23°18'E in the SE corner of the map.

The Geological Survey of Canada welcomes corrections or additional information from users.

Data may include additional features not portrayed on this map.  
See documentation accompanying the data.  
Additional references are included in the map information document.

This publication is available for free download through GEOSCAN  
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### **Map Viewing Files**

The published map is distributed as a Portable Document File (PDF), and may contain a subset of the overall geological data for legibility reasons at the publication scale.

The spatial geological data is provided in two file formats, SHP and XML, that may be imported into Geographic Information System (GIS) software for the purposes of viewing, querying, and analysis.

## ABOUT THE GEOLOGY

### Descriptive Notes

The authors have updated and revised map unit terminology from the Operation Norman map (Aitken and Cook, 1976). In general, terminology for Cambrian units is that of Dixon and Stasiuk (1998) with modifications by Fallas and MacNaughton (2012), Silurian and Devonian usage follows that of Morrow (1991), and Cretaceous to Paleocene formation names are those of Dixon (1999). Neoproterozoic to Ordovician units have recently undergone revision to their terminology, as outlined below.

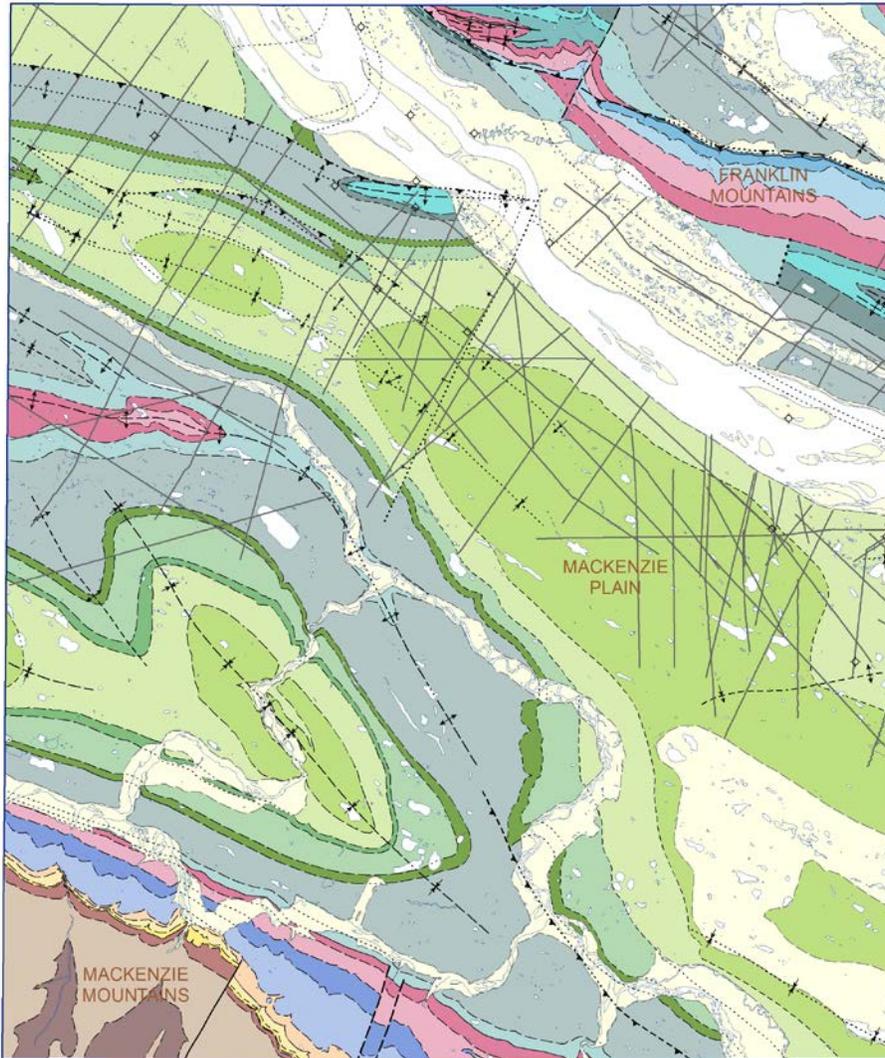
Recent stratigraphic work in the Mackenzie Mountains has formalized the Mackenzie Mountains Supergroup and revised its formation-level nomenclature. Within the Katherine Group, the Eduni, Tawu, Grafe River, Etagochile, and Shattered Range formations of Long and Turner (2012) correspond to the lower part of the Katherine Group as shown on the GSC maps for Carcajou Canyon (Aitken et al., 1974) and Norman Wells (Aitken and Cook, 1976), and to the K1 to K5 divisions of Aitken et al. (1978) and Long et al. (2008). Delineation of these new formations depends on the ability to recognize the recessive Tawu and Etagochile formations. These formations are seldom exposed in the mapping area and so the five lower formations of the Katherine Group were grouped during mapping. The McClure and Abraham Plains formations correspond to the upper Katherine Group on the Carcajou Canyon (Aitken et al., 1974) and Norman Wells (Aitken and Cook, 1976) maps, and to the K6 and K7 divisions of Aitken et al. (1978) and Long et al. (2008).

Previous work by the Geological Survey of Canada in the Norman Wells map area (Aitken and Cook, 1976) subdivided the Cambro-Ordovician Franklin Mountain Formation into three informal units. In ascending order they are: Cyclic member, Rhythmic member, and Cherty member (Norford and Macqueen, 1975). On the present maps, these older unit names correspond, in ascending order, to informal lower, middle, and upper members of the Franklin Mountain Formation. These lower, middle, and upper members correspond to the units 1, 2, and 3 of the Franklin Mountain Formation described by Turner (2011).

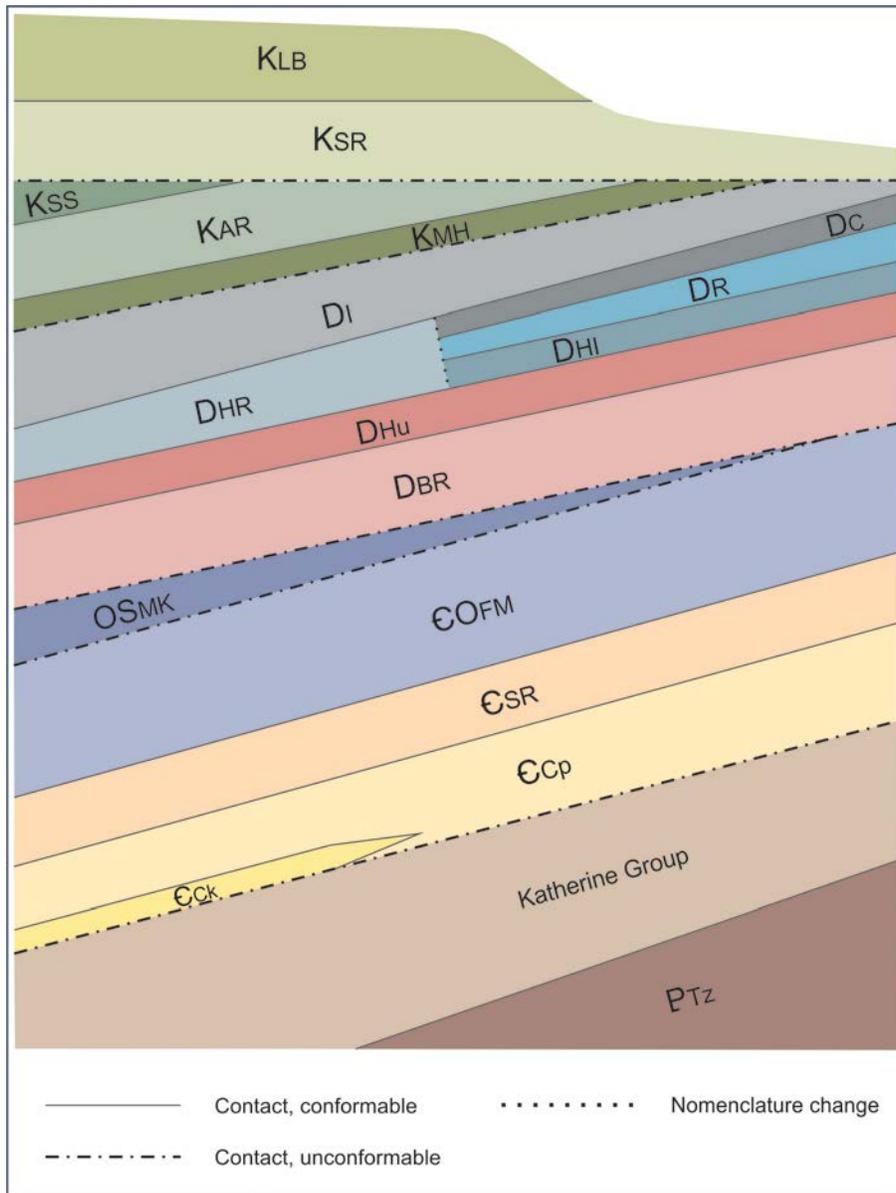
For detailed information on surficial deposits, here shown as “Quaternary sediment”, see Duk-Rodkin (2002).

The names Norman Range Thrust, Hoosier Ridge Fault, Trail Creek Fault, Oscar Lake syncline, Hoosier Ridge anticline, Majel Lake anticline, Rankin Creek syncline, Loon Creek anticline, and Twentyfive Mile Lake syncline have been introduced to facilitate discussion of these structural features. The names Rainbow Arch anticline and Imperial syncline are extended from the adjoining Sans Sault Rapids map area (Aitken and Cook, 1979). Cordilleran deformation in this map area has generated folds and thrust faults interpreted to be detached within Proterozoic strata within the Mackenzie Mountains in the southwest corner, and stepping up into Cambrian or Devonian strata to the northeast (Cook and MacLean, 1999).

Coverage of public-domain seismic-reflection data used to augment the map compilation and constrain stratigraphic relationships is shown in Figure 1. Surface and subsurface stratigraphic relationships within this map area are shown schematically in Figure 2.



**Figure 1.** Southwest Norman Wells map area (NTS 96-E/SW) showing seismic lines on record with the National Energy Board that were used to augment the bedrock geology interpretation. Line names are provided in the data files



**Figure 2.** Schematic stratigraphic relationship diagram for southwest Norman Wells map area (NTS 96-E/SW). Thinning or removal of map units beneath erosional unconformities reflects tectonic activity adjacent to the Keele Arch from the Paleozoic to the Cretaceous.

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## Coordinate System

Projection: Universal Transverse Mercator  
Units: metres  
Zone: 9  
Horizontal Datum: NAD83  
Vertical Datum: mean sea level

## Bounding Coordinates

Western longitude: 128°00'00" W  
Eastern longitude: 127°00'00" W  
Northern latitude: 65°30'00" N  
Southern latitude: 65°00'00" N

## Data Model Information

Surface bedrock data are organized into feature classes and themes consistent with logical groupings of geological features. All field observation point data are related through the Station\_ID property of the Station theme. These feature attribute names and definitions are identical in the shapefiles and the XML files.

Consult PDFs in Data folder for complete description of the feature classes, feature attributes, and attribute domains.

The Bedrock Data Model and the Bedrock Domains documents are intended to describe all bedrock features which may be compiled at the 1:50 000 scale. Therefore, some of the feature classes and feature attributes described in these documents may not be present.

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  - iii upon mutual agreement of the parties.
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This Agreement shall be construed and enforced in accordance with, and the rights of the parties shall be governed by, the laws of Ontario and Canada as applicable. The parties hereto attorn to the jurisdiction of the Superior Court of the Province of Ontario.

2. **Entire Agreement**

This Agreement constitutes the entire agreement between the parties with respect to its subject matter. This Agreement may only be amended in writing, signed by both parties, which expressly states the intention to amend this Agreement.

3. **Dispute Resolution**

If a dispute arises concerning this Agreement, the parties shall attempt to resolve the matter by negotiation.

## ACCORD DE LICENCE

### ACCORD DE LICENCE D'UTILISATION SANS RESTRICTION DE DONNÉES NUMÉRIQUES DE GÉOGRATIS

CE DOCUMENT constitue une entente légale entre vous (ci-après le " Détenteur de licence ") et SA MAJESTÉ LA REINE DU CHEF DU CANADA (ci-après le " Canada "), représentée par le Ministre des Ressources naturelles du Canada. **EN ATTEIGNANT, TÉLÉCHARGEANT, IMPRIMANT OU UTILISANT LES DONNÉES, L'INFORMATION OU LE MATÉRIEL FOURNIS OU ACCESSIBLES SELON CETTE ENTENTE, VOUS VOUS ENGAGEZ À RESPECTER LES MODALITÉS DE CET ACCORD. SI VOUS ÊTES EN DÉSACCORD AVEC CES MODALITÉS, VOUS DEVEZ IMMÉDIATEMENT ÉLIMINER TOUTE COPIE DE CES DONNÉES, INFORMATION, MATÉRIEL ET PRODUITS DÉRIVÉS.**

- I. **ATTENDU QUE** le Canada détient les droits de propriété sur les données (les " Données ") accessibles aux termes des modalités de cet Accord;
- II. **ATTENDU QUE** le Détenteur de licence désire obtenir certains droits sur les Données, sous réserve des modalités énoncées ci-après;
- III. **ATTENDU QUE** le Canada déclare avoir la pleine autorité pour accorder les droits demandés par le Détenteur de licence, sous réserve des modalités énoncées ci-après;
- IV. **ET ATTENDU QUE** les parties veulent en venir à une entente d'utilisation à partir de ce qui suit.
- V. **À CES CAUSES**, en considérant les conventions contenues dans cet Accord, les parties conviennent de ce qui suit :

#### 1.0 DÉFINITIONS

1. Données du Canada signifie toute Donnée dont le Canada détient le droit de propriété.
2. Données signifie toute donnée numérique, métadonnée ou documentation visée par les modalités de cet Accord.
3. Produits dérivés signifie tout produit, système, sous-système, appareil, composant, matériel ou logiciel qui comprend ou utilise toute partie des Données.
4. Droits de propriété intellectuelle signifie tout droit de propriété intellectuelle reconnu par la loi, y compris tout droit de propriété intellectuelle protégé par une législation telle que celle qui régit, sans être limitée à, les droits d'auteur et les brevets.

#### 2.0 CESSION D'UNE LICENCE

1. 2.1 Sous réserve des modalités du présent Accord, le Canada octroie au Détenteur de licence une licence non exclusive, sans frais ni redevances exigibles, et le droit d'exercer tous les Droits de propriété intellectuelle sur les Données. Ceci comprend le droit d'utiliser, incorporer, accorder des licences d'utilisation (avec droit subséquent d'accorder des licences d'utilisation), modifier, améliorer, développer et distribuer les Données; et de fabriquer ou distribuer des Produits dérivés.
2. Les Droits de propriété intellectuelle découlant de toute modification, amélioration, développement ou traduction des Données, ou de la fabrication de Produits dérivés, effectués par ou pour le Détenteur de licence seront détenus par le Détenteur de licence ou tout substitut identifié par le Détenteur de licence.

### **3.0 PROTECTION ET IDENTIFICATION DE LA SOURCE**

1. L'utilisation des Données ne constitue en aucune façon une reconnaissance par le Canada d'un Produit dérivé. Le Détenteur doit identifier la source de données, de la façon suivante, lorsque toute partie des Données est redistribuée ou comprise dans un Produit dérivé :  
© Le ministère des Ressources naturelles Canada. Tous droits réservés.

### **4.0 GARANTIE, EXCLUSION ET INDEMNISATION**

1. Le Canada ne fait aucune représentation ou garantie, expresse ou tacite, découlant de la loi ou d'autres sources, en ce qui concerne entre autres l'exactitude, l'utilité, la nouveauté, la validité, l'étendue, l'intégralité ou l'actualité des Données et rejette expressément toute garantie implicite de qualité loyale et marchande ou l'à propos à une fin particulière des Données. Le Canada n'assure ni ne garantit la compatibilité du site qui contient les Données avec les versions antérieures, actuelles et futures de n'importe quel fureteur.
2. Le Canada ne peut être tenu responsable par le Détenteur de licence en ce qui a trait à toute réclamation, revendication ou action en justice, quelle qu'en soit la cause, concernant toute perte ou tout préjudice ou dommage ou frais, direct ou indirect, qui pourrait résulter de la possession ou de l'utilisation des Données par le Détenteur de licence.
3. Le Détenteur de licence tiendra le Canada et ses représentants, employés, agents et exécutants, indemnes et à couvert à l'égard de toute réclamation, revendication ou action en justice, quelle qu'en soit la cause, alléguant toute perte, tout frais, toute dépense, tout dommage ou toute blessure (y compris toute blessure mortelle) qui pourrait résulter de la possession ou de l'utilisation des Données par le Détenteur de licence.
4. Le Détenteur de licence devra accorder des licences d'utilisation à toute personne ou partie qui obtient les Données ou des Produits dérivés au moyen d'un accord de licence, et cet accord devra imposer à ces personnes ou parties les mêmes modalités que celles qui sont énoncées dans la section 4.0 de cet Accord.
5. L'obligation du Détenteur de licence d'indemniser le Canada selon cet Accord ne peut affecter ni empêcher le Canada d'exercer tout autre droit selon la loi.

### **5.0 DURÉE**

1. Cet Accord entre en vigueur à partir de la date et de l'heure d'acceptation des modalités de l'Accord (Heure de l'Est) et restera en vigueur pour une période d'un (1) an, en vertu de la sous-section 5.2 et de la section 6.0 qui suivent.
2. À la fin du premier terme, cet Accord sera automatiquement renouvelé pour des termes successifs d'un (1) an, en vertu de la section 6.0 qui suit.

### **6.0 RÉSILIATION**

1. 6.1 Nonobstant la section 5.0, cet Accord peut être résilié :
  - i. automatiquement et sans préavis, si le Détenteur de licence manque à ses engagements ou obligations selon cet Accord;
  - ii. par un préavis écrit de résiliation émis par le Détenteur de licence, en tout temps, et cette résiliation prendra effet trente (30) jours suivant la réception d'un tel préavis par le Canada; ou
  - iii. par consentement mutuel des parties.

2. Lors de la résiliation de cet Accord, pour quelque raison que ce soit, les obligations qui incombent au Détenteur de licence en vertu de la section 4.0 continueront de s'appliquer et les droits du Détenteur de licence en vertu de la section 2.0 cesseront immédiatement.
3. Lors de la résiliation de cet Accord, pour quelque raison que ce soit, le Détenteur de licence devra immédiatement effacer ou détruire toutes les Données obtenues en vertu de cet Accord, ou à l'intérieur d'un délai raisonnable lorsque les Données sont nécessaires pour terminer la livraison de Produits dérivés commandés avant la résiliation de cet Accord.

## **7.0 GÉNÉRAL**

### **1. Lois d'application**

Le présent Accord est régi et interprété en vertu des lois en vigueur dans la province de l'Ontario. Les parties acceptent de tomber sous la juridiction de la Cour supérieure de la Province de l'Ontario.

### **2. Totalité de l'Accord**

Le présent Accord constitue l'intégralité de l'entente conclue entre les parties relativement à l'objet du présent Accord. Toute modification à cet Accord ne peut être que par écrit, doit porter la signature de chaque partie et exprimer clairement l'intention de modifier cet Accord.

### **3. Solution des litiges**

Si un litige survient à propos de cet Accord, les parties tenteront de le résoudre par des négociations de bonne foi.